Activity Report 2011

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6. Partnerships and Cooperations

6.1. European Initiatives

6.1.1. FP7

- **European Network of Excellence HiPEAC2 and HiPEAC3**: HiPEAC is a network of excellence on High-Performance Embedded Architectures and Compilers. It involves more than 70 European researchers from 10 countries and 6 companies, including ST, Infineon and ARM. The goal of HiPEAC is to steer European research on future processor architectures and compilers to key issues, relevant to the European embedded industry.

6.2. International Initiatives

6.2.1. INRIA Associate Teams

- **YOUHUA**: ICT-INRIA associate team. The goal of the team is to investigate a programming approach for heterogeneous multi-cores.

  The likely path forward for architectures are heterogeneous multi-cores composed of a mix of cores and hardware accelerators (ASICs or reconfigurable circuits). Now, whether the architectures are homogeneous multi-cores or heterogeneous multi-cores, the difficulty to efficiently program such architectures remains the key issue. We propose a programming approach that is pragmatic and capable of letting non-expert users take advantage of the performance of homogeneous and heterogeneous multi-cores. Rather than asking programmers to understand architectures and write parallel or RTL (for accelerators) versions of their code, we ask programmers to explicit the algorithms they are using within their codes, and we rely on expert programmers to provide efficient parallel or RTL implementations of these algorithms. Not only this approach can make it possible for non-expert users to take advantage of complex architectures, but it also makes programs portable across a broad range of architectures, and furthermore, it considerably expands the opportunities for automatically tuning applications and architectures.

6.2.2. Visits of International Scientists

- Jing Huang sent by ICT and Chinese Academy of Science for 10 months in France, for cooperation on reconfigurable accelerator.
- Numerous stays in China in 2011 by Olivier Temam (about once per month).

6.2.3. Participation In International Programs

- **YOUHUA at LIAMA**: LIAMA is (originally) an INRIA-Chinese Academy of Sciences lab (now Europe-China CS lab), and we just established a joint team at LIAMA, also called YOUHUA. Unlike YOUHUA, this joint team is INRIA-ICT-EPFL. The goal is both the design of reconfigurable accelerators, and programming approaches for heterogeneous multi-cores.
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR projects

8.1.1.1. AbstractCell

Title: Formal abstraction of quantitative semantics for protein-protein interaction cellular network models
Instrument: ANR-Chair of Excellence (Junior, long term)
Duration: December 2009 - December 2013
Coordinator: INRIA (France)
Others partners: None
See also: http://www.di.ens.fr/feret/abstractcell
Abstract: The overall goal of this project is to investigate formal foundations and computational aspects of both the stochastic and differential approximate semantics for rule-based models. We want to relate these semantics formally, then we want to design sound approximations for each of these semantics (by abstract interpretation) and investigate scalable algorithms to compute the properties of both the stochastic and the differential semantics. Jérôme Feret is the principal investigator for this project.

8.1.1.2. AstréeA

Title: Static Analysis of Embedded Asynchronous Real-Time Software
Type: ANR Ingénierie Numérique Sécurité 2011
Instrument: ANR grant
Duration: January 2012 - December 2015
Coordinator: Airbus France (France)
Others partners: École normale supérieure (France)
See also: http://www.astreea.ens.fr
Abstract: The focus of the AstréeA project is on the development of static analysis by abstract interpretation to check the safety of large-scale asynchronous embedded software. During the Thésee ANR project (2006–2010), we developed a concrete and abstract models of the ARINC 653 operating system and its scheduler, and a first analyzer prototype. The gist of the AstréeA project is the continuation of this effort, following the recipe that made the success of Astrée: an incremental refinement of the analyzer until reaching the zero false alarm goal. The refinement concerns: the abstraction of process interactions (relational and history-sensitive abstractions), the scheduler model (supporting more synchronisation primitives and taking priorities into account), the memory model (supporting volatile variables), and the abstraction of dynamical data-structures (linked lists). Patrick Cousot is the principal investigator for this project.

8.1.1.3. Verasco

Title: Formally-verified static analyzers and compilers
Type: ANR Ingénierie Numérique Sécurité 2011
Instrument: ANR grant
ABSTRACTION

Duration: Septembre 2011 - September 2015
Coordinator: INRIA (France)

Others partners: Airbus France (France), IRISA (France), INRIA Saclay (France)

See also: http://www.systematic-paris-region.org/fr/projets/verasco

Abstract: The usefulness of verification tools in the development and certification of critical software is limited by the amount of trust one can have in their results. A first potential issue is unsoundness of a verification tool: if a verification tool fails (by mistake or by design) to account for all possible executions of the program under verification, it can conclude that the program is correct while it actually misbehaves when executed. A second, more insidious, issue is miscompilation: verification tools generally operate at the level of source code or executable model; a bug in the compilers and code generators that produce the executable code that actually runs can lead to a wrong executable being generated from a correct program.

The project VERASCO advocates a mathematically-grounded solution to the issues of formal verifying compilers and verification tools. been mechanically proved to be free of any miscompilation will be continued. Finally, the tool qualification issues that must be addressed before formally-verified tools can be used in the aircraft industry, will be investigated.

8.2. European Initiatives

8.2.1. EU Project

8.2.1.1. MBAT

Title: Combined Model-based Analysis & Testing of Embedded Systems
Type: Artemis Call 10
Instrument: FP7 project
Duration: November 2011 - October 2014
Coordinator: Daimler (Germany)

Others partners: 38 partners in Austria, Denmark, Estonia, France, Germany, Italy, Sweden, and United Kingdom

See also: http://www.artemis-ia.eu/project/index/view/?project=29

Abstract: MBAT will mainly focus on providing a technology platform for effective and cost-reducing validation and verification of embedded systems, focusing primarily on transportation domain, but also to be used in further domains. The project involves thirty three European industrial (large companies and SMEs) and five academic partners. Radhia Cousot is the principal investigator for this project.

8.2.1.2. MemCad

Title: Memory Compositional Abstract Domains
Type: IDEAS
Instrument: ERC Starting Grant (Starting)
Duration: October 2011 - September 2016
Coordinator: INRIA (France)

Others partners: none

See also: http://www.di.ens.fr/ rival/memcad.html
Abstract: The MemCAD project aims at setting up a library of abstract domains in order to express and infer complex memory properties. It is based on the abstract interpretation frameworks, which allows to combine simple abstract domains into complex, composite abstract domains and static analyzers. While other families of abstract domains (such as numeric abstract domains) can be easily combined (making the design of very powerful static analyses for numeric intensive applications possible), current tools for the analysis of programs manipulating complex abstract domains usually rely on a monolithic design, which makes their design harder, and limits their efficiency. The purpose of the MemCAD project is to overcome this limitation. Our proposal is based on the observation that the complex memory properties that need be reasoned about should be decomposed in combinations of simpler properties. Therefore, in static analysis, a complex memory abstract domain could be designed by combining many simpler domains, specific to common memory usage patterns. The benefit of this approach is twofold: first it would make it possible to simplify drastically the design of complex abstract domains required to reason about complex softwares, hereby allowing certification of complex memory intensive softwares by automatic static analysis; second, it would enable to split down and better control the cost of the analyses, thus significantly helping scalability. As part of this project, we propose to build a static analysis framework for reasoning about memory properties, and put it to work on important classes of applications, including large softwares.

8.3. International Initiatives

8.3.1. NSFC Project

8.3.1.1. NSFC

Title: Analysis and Verification of Dependable Cyber-Physical Software
Type: National Natural Science Foundation of China (NSFC)
Duration: January 2012 - December 2016
Coordinator: National University of Defense Technology (China)
Others partners: National University of Defense Technology (China), Seoul National University (Korea)
Abstract: The project addresses analysis and verification issues related to dependability properties of Cyber Physical Systems (CPS) software: safety (such as the numerical or and memory related runtime errors), quantitative properties (such as the worst-case execution time, upper bound of the memory consumption, etc.), stability and robustness (due to intrinsic uncertainty of CPS), as well as properties of hybrid system (which provides a model for describing the coordination of computation and physical, discrete and continuous processes). The project is expected to advance the analysis and verification methodology for dependable CPS software so as to contribute to the dependability assurance of CPS software in mission critical applications. Patrick Cousot is the principal investigator for this project.

8.3.1.2. Visiting professors

Yanjun Wen is associate professor at the Department of Computer Science and Technology, College of Computer, National University of Defense Technology, Changsha, P. R. China. He is visiting the team from June 2011 to May 2012 and is interested in the static analysis of parallel software by abstract interpretation.
Roberto Giacobazzi, professor at the University of Verona, Italy, visited in spring 2011.
Andreas Podelski, professor at the University of Freiburg, Germany, visited in fall 2011.

8.3.1.3. Internship

Marie Pelleau is a third year PhD student from the University of Nantes (France) under the supervision of Frédéric Benhamou, Pascal Van Hentenryck, and Charlotte Truchet. She spent one month (November 2011) in the team, under the supervision of Antoine Miné, on the application of numerical abstract domains (and in particular, the Apron library, 5.1) to constraint programming.
David Delmas is an engineer at Airbus France on educational leave to pursue the 2nd year of the Parisian Master of Research in Computer Science (MPRI) and a visitor in the team from September 2011 to August 2012.

Suzanne Renard is a third year student at École des Mines de Paris (France). She spent six months (September 2010 to February 2011) in the team, under the supervision of Xavier Rival; she was working on the extension of the XISA shape analysis frameworks in order to express set properties.
8. Partnerships and Cooperations

8.1. HiPEAC2 NoEs

Participants: François Bodin, Pierre Michaud, Erven Rohou, André Seznec.

F. Bodin, P. Michaud, A. Seznec and E. Rohou are members of the European Network of Excellence HiPEAC2. HiPEAC2 addresses the design and implementation of high-performance commodity computing devices in the 10+ year horizon, covering both the processor design, the optimising compiler infrastructure, and the evaluation of upcoming applications made possible by the increased computing power of future devices.

The collaboration with University of Cyprus (Damien Hardy’s internship) has been funded by the HiPEAC2 NoE.

8.2. Brittany region fellowship

Participants: Ricardo Andrés Velasquéz, Pierre Michaud, André Seznec.

The Brittany region is funding a Ph.D. fellowship for Ricardo Velasquez on the topic “Fast hybrid multicore architecture simulation”.

8.3. PetaQCD

Participants: Junjie Lai, André Seznec.

Simulation of Lattice QCD is a challenging computational problem that requires very high performance exceeding sustained Petaflops/s. The ANR PetaQCD project combines research groups from computer science, physics and two SMEs (CAPS Entreprise, Kerlabs) to address the challenges of the design of LQCD oriented supercomputer.

8.4. DAL: ERC AdG 2010- 267175, 04-2011/03-2016


André Seznec has received an ERC Advanced grant.

We envision that, around 2020, the processor chips will feature a few complex cores and many (may be 1000s) simpler, more silicon and power effective cores. In the DAL research project, we will explore the microarchitecture techniques that will be needed to enable high performance on such heterogeneous processor chips. Very high performance will be required on both sequential sections -legacy sequential codes, sequential sections of parallel applications- and critical threads on parallel applications -e.g. the main thread controlling the application. Our research will focus on enhancing single process performance. On the microarchitecture side, we will explore both a radically new approach, the sequential accelerator, and more conventional processor architectures. We will also study how to exploit heterogeneous multicore architectures to enhance sequential thread performance.

For more informations, see http://www.irisa.fr/alf/dal .
7. Partnerships and Cooperations

7.1. Regional Initiatives

Nicolas Broutin has obtained two years funding from Egide to support a collaboration on geometric data structures with Ralph Neininger from the University of Frankfurt.

7.2. National Initiatives

Aléa is a national working group dedicated to the analysis of algorithms and random combinatorial structures. It is a meeting place for mathematicians and computer scientists working in the area of discrete models. It is currently supported by CNRS (GDR IM) and was globally animated by Philippe Flajolet. In March 2011 the yearly meeting has gathered in Luminy over 80 participants from about 20 different research laboratories throughout France.

In September 2009, the Algorithms project has started a new participation in the programme funded by the National Research Agency (ANR) entitled BOOLE for “Quantifying Boolean Frameworks”. Four teams are involved: Algorithms from Inria Paris–Rocquencourt, the Universities of Caen, Versailles (coordinator), and Provence Aix–Marseille 1; the project is for 4 years until August 2013. The Inria Team also includes researchers at the École Normale Supérieure (ENS Ulm): Guilhem Semerjian and Jean Vuillemin.

7.3. International Initiatives

7.3.1. Visits of International Scientists

James Davenport, from the University of Bath (UK) has been invited for one month in April 2011. At this occasion, [15] was completed.

Other visitors for shorter periods were: Manuel Kauers, RISC, Linz (Austria), Ziming Li (Key Laboratory of Mathematics Mechanization of the Chinese Academy of Mathematics and System Sciences, Beijing).
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. CIM PACA

Participants: Robert de Simone, Jean-François Le Tallec, Carlos Gomez Cardenas.

This ambitious regional initiative is intended to foster collaborations between local PACA industry and academia partners on the topics of microelectronic design, though mutualization of equipments, resources and R&D concerns. We are so far actively participating in the Design Platform (one of the three platforms launched in this context), of which INRIA is a founding member.

This year the platform acquired more EDA tools, such as Synopsys Virtualizer (comprising the former CoWare virtual platform environment), and Docea Power AcePlorer (which we are using in the course of the ANR HeLP project). Several Aoste members attended specific trainings on these tools.

Jean-François Le Tallec is currently completing his PhD thesis (expected January 2012), which was partly funded on the CIM PACA initiative. Apart from this, which will close the lifespan of the Sys2RTL CIM PACA project, we are looking for further collaborative associations including the team of Michel Auguin at CNRS UMR LEAT, Texas Instruments, and maybe Synopsys amongst other partners. Discussions for project submissions are under way (one difficulty here is that US companies are not familiar with european or national collaborative fundings).

8.2. National Initiatives

8.2.1. ANR RT-Simex

Participants: Julien deAntoni, Kelly Garces Pernett, Frédéric Mallet.

The RT-Simex project is dedicated to the reverse engineering of analysis traces of simulation and execution back up to the source code, or in our case most likely into the original models in a MARTE profile representation. The prime contractor is ObEo, a software publishing company based in Nantes.

8.2.2. ANR HeLP

Participants: Jean-François Le Tallec, Carlos Gomez Cardenas, Dumitru Potop Butucaru, Robert de Simone.

The ANR HeLP project deals with joint modeling of functional behavior and energy consumption for the design of low-power heterogeneous SoCs. Partners are ST Microelectronics and Docea Power (SME) as industrial; INRIA, UNS (UMR LEAT), and VERIMAG (coordinator) as academics. Our goal in this project is twofold: first, combine SoC modeling with temporal behavior and logical time (as obtained in the ID/TL-M collaboration, see 7.1) with energy/power modeling as extra annotations on MARTE models; second, compare the capacities of high-level SystemC TLM abstraction with that of Esterel seen as a multiklock formalism based on logical abstract time.

The PhD thesis of Jean-François Le Tallec, originally funded in the CIM PACA programme, is being continued as part of the HeLP project. Additionally, part of Carlos Gomez Cardenas PhD work on metamodelling in MARTE of power consumption and links to dedicated tools is also presented to this project (in connection with complementary work at LEAT on this topic).

8.2.3. FUI Lambda

Participants: Charles André, Frédéric Mallet.
In the context of embedded software deployed on "off the shelf" execution platforms, the LAMBDA project has two major goals:

- To demonstrate the technical feasibility and the interest of model libraries by formalizing the key properties of execution platforms,
- To reconcile appropriated standards (SysML, MARTE, AADL, IP-XACT) with de facto standards (already implemented by widespread analysis and simulation tools.)

In this context we provided expertise mainly on the SyncCharts, MARTE, and SysML formalisms (our involvement in this project is only marginal, in support of other INRIA teams). The final project review was held at the end of September, 2011.

8.2.4. FUI PARSEC

Participants: Dumitru Potop Butucaru, Thomas Carle, Virginia Papailiopoulos, Yves Sorel.

The Parsec project is a large collaboration with partners such as Thales, CEA, Elidiss, INRIA, Systerel, OpenWide, Alstom, and TelecomParisTech. The project aims at defining a framework for the development of distributed real-time embedded systems that are subject to strict certification standards such as DO-178B (for avionics), IEC 61508 (for transportation systems), or ISO/IEC 15408 (the Common Criteria for information technology security evaluation).

The AOSTE team uses its expertise in the modeling and distributed real-time implementation of embedded applications using synchronous formalisms and associated tools. The two main scientific challenges of the project are (1) a better modeling of the distributed implementation architectures, allowing code generation for novel architectures and better code generation for architectures we currently handle, and (2) the modeling and efficient implementation of mode changes, as they are specified in an industrial context.

Virginia Papailiopoulos was partially funded as post-doc on this project, which will also finance the PhD scholarship of Thomas Carle.

8.2.5. FUI P

Participants: Dumitru Potop Butucaru, Yves Sorel.

The main purpose of this project is to define a Pivot format that allows the automatic generation of certified code for safety critical applications. Partners of this project are: Aboard, ACG, Airbus, Adacore, Altair, Astrium, Atos, Continental, ENPC, INRIA, IRIT, LABSTICC, ONERA, RCF, SAGEM, Scilab, STI, Thales-AS, Thales-AV.

The project was only recently started, and first concrete results are expected for next year.

8.2.6. AS GeMoC

Participants: Julien deAntoni, Kelly Garces Pernett, Frédéric Mallet.

The purpose of the Action Spécifique by CNRS is to gather the French research community working around heterogeneous modeling of complex systems. Funding was granted for a couple of internal visits and plenary meetings this year. TimeSquare was presented in this context, and a survey of methods (including ours) is being conducted.

8.2.7. CNRS GDR ASR ACTRISS group

Participant: Laurent George.

The ACTRISS working group, supported by GDR ASR (CNRS, France), is meant to federate and promote research on real-time systems in France. A workshop on multiprocessor systems was organized in this framework in May 2011 (see http://www-roc.inria.fr/who/Laurent.George/ACTRISS/).
8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. CESAR

**Participants:** Régis Gascon, Yves Sorel, Robert de Simone.

Title: CESAR
Duration: February 2009 - July 2012
Coordinator: AVL - GmbH (Austria)

Others partners: AIRBUS Operations GbmH (Germany), AIRBUS Operations SAS (France), ABB AS (Norway), ABB AB (Sweden), AbsInt Angewandte Informatik GmbH (Germany), ACCIONA Infraestructuras S.A. (Spain), Ansaldo STS S.p.A. (Italy), ASTRIMUM SAS (France), AIRBUS Operations Limited (United Kingdom), Aristotle University of Thessaloniki (Greece), Commissariat à l’Énergie Atomique (France), CNRS (France), Centro Ricerche Fiat S.C.p.A. (Italy), Critical Software S.A. (Poland), Danieli Automation S.p.A. (Italy), Delphi France SAS (France), Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany), Dassault Systemes (France), EADS Deutschland GmbH (Germany), Fondaciòn Tecnia Research & Innovation (Italy), ESTEREL Technologies SA (France), Fraunhofer Gesellschaft zur Förderung der Angewandten Forschung e.V. (Germany), Avuation Software Limited (United Kingdom), Hellenic Aerospace Industry S.A. (Greece), Infineon Technologies Austria AG (Austria), Infineon Technologies AG (Germany), Institut National de Recherche en Informatique et Automatique (France), ATHENA - Industrial Systems Institute (Greece), Kungliga Tekniska Högskolan (Sweden), Norwegian University of Science and Technology (Norway), National Technical University of Athens (Greece), OFFIS e.V. (Germany), Office national d’Études et de Recherches Aéronautiques (France), BTC - Embedded Systems AG (Germany), Oxford University (United Kingdom), Sagem Défense Sécurité (France), AleniaSIA Spa (Italy), Siemens AG (Germany), Stiftelsen SINTEF (Norway), Quintec Associates (Thales Consulting and Engineering) (United Kingdom), Thales Communications S.A. (France), Thales Avionics S.A. (France), Thales TRT (France), Alma Mater Studium - Università di Bologna (Italy), The University of Manchester (United Kingdom), Università degli Studi di Trieste (Italy), The Virtual Vehicle Competence Center (Austria), Volvo Technology Corporation (Sweden), Messier-Bugatti S.A. (France), TURBOMECA (France), SNECMA S.A. (France), Geensoft (France), Selex Sistemi Integrati (Italy).

See also: [http://www.cesarproject.eu/](http://www.cesarproject.eu/)

Abstract: CESAR stands for Cost-efficient methods and processes for safety relevant embedded systems and is a European funded project from ARTEMIS JOINT UNDERTAKING (JU). The three transportation domains automotive, aerospace, and rail, as well as the automation domain share the need to develop ultra-reliable embedded systems to meet societal demands for increased mobility and ensuring safety in a highly competitive global market. To maintain the European leading edge position in the transportation as well as automation market, CESAR aims to boost cost efficiency of embedded systems development and safety and certification processes by an order of magnitude. CESAR pursues a multi-domain approach integrating large enterprises, suppliers, SME’s and vendors of cross sectoral domains and cooperating with leading research organizations and innovative SME’s.

8.3.1.2. PRESTO

**Participants:** Frédéric Mallet, Marie-Agnès Peraldi Frati, Julien DeAntoni.

Title: PRESTO
Duration: April 2011 - March 2014
Coordinator: Miltech (Greece)
Others partners: TELETEL S.A. (Greece), THALES Communications (France), Rapita Systems Ltd. (United Kingdom), VTT (Finland), Softeam (France), THALES (Italy), MetaCase (Finland), INRIA (France), University of L’Aquila (Italy), MILTECH HELLAS S.A (Greece), PragmaDev (France), Prismetech (United Kingdom), Sarokal Solutions (Finland).

See also: http://www.presto-embedded.eu/

Abstract: The PRESTO project aims at improving test-based embedded systems development and validation, while considering the constraints of industrial development processes. This project is based on the integration of test traces exploitation, along with platform models and design space exploration techniques. Such traces are obtained by execution of test patterns, during the software integration design phase, meant to validate system requirements. The expected result of the project is to establish functional and performance analysis and platform optimisation at early stage of the design development. The approach of PRESTO is to model the software/hardware allocation, by the use of modelling frameworks, such as the UML profile for model-driven development of Real Time and Embedded Systems (MARTE). The analysis tools, among them timing analysis including Worst Case Execution Time (WCET) analysis, scheduling analysis and possibly more abstract system-level timing analysis techniques will receive as inputs on the one hand information from the performance modelling of the HW/SW-platform, and on the other hand behavioural information of the software design from tests results of the integration test execution.

The PRESTO project (ARTEMIS-2010-1-269362) is co-funded by the European Commission under the ARTEMIS Joint Undertaking Programme.

8.3.2. Collaborations in European Programs, except FP7

8.3.2.1. ITEA2 Timmo2U

Participants: Marie-Agnès Peraldi Frati, Julien DeAntoni, Arda Goknil, Jean-Vivien Millo, Yves Sorel.

Program: ITEA2

Project acronym: Timmo2Use

Project title: TIMing MOdel, TOols, algorithms, languages, methodology, and USE cases

Duration: October 2010 - October 2012

Coordinator: Volvo Technology AB (Sweden)

Other partners: AbsInt Angewandte Informatik GmbH (Germany), Arcticus Systems AB (Sweden), Chalmers University of Technology (Sweden), Continental Automotive GmbH (Germany), Delphi France SAS (France), dSPACE GmbH (Germany), INCHRON GmbH (Germany), Institut National de Recherche en Informatique et Automatique (France), Mälardalen University (Sweden), Rapita Systems Ltd. (United Kingdom), RealTime-at-Work (France), Robert Bosch GmbH (Germany), Syntavision GmbH (Germany), Technische Universität Braunschweig (Germany), Time Critical Networks (Sweden), Universität Paderborn (Germany).

See also: http://timmo-2-use.org/

Abstract: TIMMO develops different types of timing constraints and dynamic behaviour in the supply chain of the complex development process is of crucial importance when designing distributed real-time automotive systems. TIMMO-2-USE stands for TIMing MOdel - TOols, algorithms, languages, methodology, and USE cases which summarizes the main objectives of the project, i.e., the development of novel tools, algorithms, languages, and a methodology validated by use cases.

The project provides partial funding for the postdoctoral positions of Jean-Vivien Millo and Arda Goknil.
8.3.2.2. ITEA2 OpenProd

**Participants:** Simon Nivault, Yves Sorel.

Program: ITEA2

Project acronym: OpenProd

Project title: Open Model-Driven Whole-Product Development and Simulation Environment

Duration: June 2009 - May 2012

Coordinator: Siemens Industrial TurboMachinery AB (Sweden)

Other partners: Appedge (France), Bosch Rexroth AG (Sweden), CEA LIST (France), EADS Innovation Works (France), Electricité De France (France), Equa Simulation AB (Sweden), ETH Zürich (Switzerland), Fachhochschule Bielefeld (Germany), Fraunhofer FIRST (Germany), IFP (France), INRIA Rocquencourt (France), INSA Lyon (France), Linköping University (Sweden), LMS Imagine (France), MathCore Engineering AB (Sweden), Metso Automation (France), Nokia (Finland), Plexim GmbH (Germany), Pöyry Forest Industry (Finland), PSA Peugeot Citroen (France), Siemens AG, Sector Energy (Germany), SKF Sverige AB (Sweden), Technische Universität Braunschweig (Germany), TLK Thermo GmbH (Germany), VTT Technical Research Centre (Finland), XRG Simulation GmbH (Germany).

See also: [http://www.ida.liu.se/~pelab/OpenProd/](http://www.ida.liu.se/~pelab/OpenProd/)

Abstract: The OPENPROD project is developing an open whole-product, model-driven systems development, modelling and simulation (M&S) environment that integrates the leading open industrial software development platform Eclipse with open-source modelling and simulation tools such as OpenModelica and industrial M&S tools and applications. The project will enable a more formalised validation of production to cut time to market and ensure higher quality, using open solutions which will have a high impact, based on easy uptake and wide dissemination.

8.4. International Initiatives

8.4.1. INRIA International Partners

We are continuing a collaboration with East China Normal University (ECNU) in Shanghai, through the Software Engineering Institute headed by He Jifeng. This collaboration is shared with the OASIS EPI. As part of this we held a dedicated Workshop in Shanghai in November, met some of the LIAMA staff while there, and participated to a proposal for a new Associated Team mainly headed by OASIS. We are also hosting for a year Yin Ling, a PhD student from ECNU, on a chinese government grant.

8.4.2. Participation In International Programs

8.4.2.1. NoE Artist-Design

We are affiliated to this european Network of Excellence Artist-Design ([http://www.artist-embedded.org/artist/](http://www.artist-embedded.org/artist/)), which sponsors events in our field.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Cible Grant from Région Rhône-Alpes


Since October 2008, we have obtained a 3-year grant from Région Rhône-Alpes. That grant has funded a PhD student, Mioara Joldeș, who defended her PhD thesis on September 26, 2011. The project consists in automating as much as possible the generation of code for approximating functions. Instead of calling functions from libraries, we wish to elaborate approximations at compile-time, in order to be able to directly approximate compound functions, or to take into account some information (typically, input range information) that might be available at that time. In this project, we collaborate with the STMicroelectronics’ Compilation Expertise Center in Grenoble (C. Bertin, H. Knochel, and C. Monat). STMicroelectronics is funding another PhD grant on these themes.

8.2. National Initiatives

8.2.1. ANR HPAC Project

Participants: Claude-Pierre Jeannerod, Nicolas Louvet, Nathalie Revol, Damien Stehlé, Philippe Théveny, Gilles Villard.

“High-performance Algebraic Computing” (HPAC) is a four year ANR project that will start in January 2012. HPAC is headed by Jean-Guillaume Dumas (CASYS team, LJK laboratory, Grenoble); it involves Arénaire as well as the INRIA project-team MOAIS (LIG, Grenoble), the INRIA project-team SALSA (LIP6 lab., Paris), the ARITH group (LIRMM laboratory, Montpellier), and the HPC Project company.

The overall ambition of HPAC is to provide international reference high-performance libraries for exact linear algebra and algebraic systems on multi-processor architecture and to influence parallel programming approaches for algebraic computing. The central goal is to extend the efficiency of the LinBox and FGb libraries to new trend parallel architectures such as clusters of multi-processor systems and graphics processing units in order to tackle a broader class of problems in lattice cryptography and algebraic cryptanalysis. HPAC will conduct researches along three axes:

- A domain specific parallel language (DSL) adapted to high-performance algebraic computations;
- Parallel linear algebra kernels and higher-level mathematical algorithms and library modules;
- Library composition and innovative high performance solutions for cryptology challenges.

8.2.2. ANR TaMaDi Project

Participants: Nicolas Brisebarre, Florent de Dinechin, Guillaume Hanrot, Vincent Lefèvre, Érik Martin-Dorel, Micaela Mayero, Jean-Michel Muller, Andrew Novocin, Ioana Pasca, Damien Stehlé, Sergei Torres.

The TaMaDi project (Table Maker’s Dilemma, 2010-2013) is funded by the ANR and headed by Jean-Michel Muller. It was submitted in January 2010, accepted in June, and started in October 2010. The other French teams involved in the project are the MARELLE team-project of INRIA Sophia Antipolis-Méditerranée, and the PEQUAN team of LIP6 lab., Paris.
The aim of the project is to find “hardest to round” (HR) cases for the most common functions and floating-point formats. In floating-point (FP) arithmetic having fully-specified “atomic” operations is a key-requirement for portable, predictable and provable numerical software. Since 1985, the four arithmetic operations and the square root are IEEE specified (it is required that they should be correctly rounded: the system must always return the floating-point number nearest the exact result of the operation). This is not fully the case for the basic mathematical functions (sine, cosine, exponential, etc.). Indeed, the same function, on the same argument value, with the same format, may return significantly different results depending on the environment. As a consequence, numerical programs using these functions suffer from various problems. The lack of specification is due to a problem called the Table Maker’s Dilemma (TMD). To compute \( f(x) \) in a given format, where \( x \) is a FP number, we must first compute an approximation to \( f(x) \) with a given precision, which we round to the nearest FP number in the considered format. The problem is the following: finding what the accuracy of the approximation must be to ensure that the obtained result is always equal to the “exact” \( f(x) \) rounded to the nearest FP number. In the last years, our team-project and the CACAO team-project of INRIA Nancy-Grand Est designed algorithms for finding hardest-to-round cases. These algorithms do not allow to tackle with large formats. The TaMaDi project mainly focuses on three aspects:

- **big precisions**: we must get new algorithms for dealing with precisions larger than double precision. Such precisions will become more and more important (even if double precision may be thought as more than enough for a final result, it may not be sufficient for the intermediate results of long or critical calculations);
- **formal proof**: we must provide formal proofs of the critical parts of our methods. Another possibility is to have our programs generating certificates that show the validity of their results. We should then focus on proving the certificates;
- **aggressive computing**: the methods we have designed for generating HR points in double precision require weeks of computation on hundreds of PCs. Even if we design faster algorithms, we must massively parallelize our methods, and study various ways of doing that.

There was a meeting in Sophia-Antipolis in February 2011, and two other ones in Lyon in June and December 2011. The various documents can be found at [http://tamadiwiki.ens-lyon.fr/tamadiwiki/index.php/Main_Page](http://tamadiwiki.ens-lyon.fr/tamadiwiki/index.php/Main_Page).

### 8.2.3. ANR TCHATER Project
**Participants:** Florent de Dinechin, Honoré Takeugming, Gilles Villard.

The TCHATER project (Terminal Cohérent Hétérodyne Adaptatif TEmps Réel, 2008-2010) is a collaboration between Alcatel-Lucent France, E2V Semiconductors, GET-ENST and the INRIA Arénaire and ASPI project/teams. Its purpose is to demonstrate a coherent terminal operating at 40Gb/s using real-time digital signal processing and efficient polarization division multiplexing. In Lyon, we studied the FPGA implementation of specific algorithms for polarization demultiplexing and forward error correction with soft decoding. TCHATER was extended by the ANR until 9/06/2011, which allowed us to finalize the demonstrator.

### 8.2.4. ANR LaRedA Project
**Participants:** Fabien Laguillaumie, Adeline Langlois, Ivan Morel, Xavier Pujol, Damien Stehlé.

The LaRedA project (Lattice Reduction Algorithms, 2008-2011) is funded by the ANR and headed by Brigitte Vallée (CNRS/GREYC) and Valérie Berthé (CNRS/LIRMM). The aim of the project is to finely analyze lattice reduction algorithms such as LLL, by using experiments, probabilistic tools and dynamic analysis. Among the major goals are the average-case analysis of LLL and its output distribution. In Lyon, we concentrate on the experimental side of the project (by using fpLLL and MAGMA) and the applications of lattice reduction algorithms to cryptography.
8.3. European Initiatives

8.3.1. Other European Initiatives

- Guillaume Hanrot and Damien Stehlé collaborate with Cong Ling (Imperial College London, UK) on lattices and communication theory. The collaboration is jointly funded by the CNRS and the Royal Society, from January 2011 to December 2012.

8.4. International Initiatives

8.4.1. INRIA International Partners


8.4.2. Visits of International Scientists

- San Ling (Nanyang Technological University, Singapore) visited for two months (March and April), for collaborating on lattice-based cryptography. Visit partly funded by NTU and Inria Rhône-Alpes (invited researcher).
- Xiao-Wen Chang (McGill University, Canada) visited for one month (July), for collaborating on the numerical aspects of lattice reduction algorithms. Visit funded by ENS de Lyon (invited professor).
- Ron Steinfeld (Macquarie University, Australia) visited for one month (August), for collaborating on lattice-based cryptography. Visit funded by the French Embassy in Australia.

8.4.3. Participation In International Programs

- Guillaume Hanrot and Damien Stehlé participate in the LaBaCry project (Lattice-Based Cryptography), with San Ling and Huaxiong Wang (Cryptography and Coding group of Nanyang Technological University, Singapore). Project jointly funded by NTU and the MERLION program from the French Embassy in Singapore.
- Damien Stehlé is a Partner Investigator in the Australian Research Council Discovery Grant Lattices as a Constructive and Destructive Tool in Cryptography, with Christophe Doche, Igor Shparlinski and Ron Steinfeld (Macquarie University).
- Florent de Dinechin was invited 4 months by Nizhniy Novgorod State University (Russia).
8. Partnerships and Cooperations

8.1. National Initiatives

+ NWO TOP proposal “Domain-Specific Languages: A Big Future for Small Programs”
+ “Next Generation Auditing: Data Assurance as a Service” (Jacquard project)
+ “Escher: End-user Scripting for High-level softwarE Representation” (NWO)
+ “GrammarLab: Foundations For a Grammar Laboratory” (NWO)
+ “Model Driven Engineering in Digital Forensics” (NWO)
+ “EQuA: Early Quality Assurance in Software Production”

8.2. International Initiatives

8.2.1. Visits of International Scientists

- Prof. Dr. Michael Godfrey (University of Waterloo, Canada) is visiting for one year, starting August 2011.
- Dr. Anya Helene Bagge (Institutt for Informatikk Universitetet i Bergen, Norway) was visiting us for one year until October 2011.
- Prof. Dr. William Cook visited us for a week (University of Texas, U.S.A.)
- Prof. Dr. Eric van Wyk visited us for one week (University of Minnesota, U.S.A.)
- Prof. Dr. Terence Parr visited us for two days (University of San Francisco, U.S.A.)
- Dr. Markus Völter visited us for two days (Germany)
- Dr. Wolgang Lohmann visited us for a day (EMPA, Switzerland)
- Prof. Dr. Ralf Lämmel visited us for a week (Universität Koblenz-Landau, Germany)
- Dr. Vlad Rusu visited us several times for two days (INRIA Lille, France)

8.2.1.1. Internships

- Wietse Venema 2011/2012
- Randy Fluit 2011
- Ahmadi Nasab 2010/2011
- Jouke Stoel 2011
- Christian Köppe 2011
- Davy Landman 2011
- Jan de Mooij 2011
8. Partnerships and Cooperations

8.1. Regional Initiatives

Organisation by A. Tisserand of working group on cryptography and digital security between research teams from University of Brest, University of Lorient and University of Rennes.

The Grappas project, funded by the Equipe Projet Transversale program from Université Européenne de Bretagne (UEB) aims at evaluating (and improving) the efficiency of automatic parallelization techniques for accelerating electromagnetic FDTD simulations of antennas on GPUs (Graphical Processing Units). The project is a joint project between IETR (D. Thouroude and R. Sauleau) and IRISA (S. Derrien).

8.2. National Initiatives

The CAIRN team has currently some collaboration with the following laboratories: CEA List, SATIE ENS Cachan, LEAT Nice, Lab-Sticc (Lorient, Brest), LIRMM (Montpellier, Perpignan), ETIS Cergy, LIP6 Paris, IETR Rennes, Ireena Nantes; and with the following INRIA project-teams: Arénaire, Compsys, Swing, Symbiose, TexMex.

The team participates in the activities of the following research organization of CNRS (GdR for in french "Groupe de Recherche"):

- GdR SOC-SIP (System On Chip & System In Package), working groups on reconfigurable architectures, embedded software for SoC, low power issues. See [http://www2.lirmm.fr/~w3mic/SCSIP/index.php](http://www2.lirmm.fr/~w3mic/SCSIP/index.php). CAIRN is the leader of the group on reconfigurable architectures.
- GdR ISIS (Information Signal ImageS), working group on Algorithms Architectures Adequation.
- GdR ASR (Architectures Systèmes et Réseaux)
- GdR IM (Informatique Mathématiques), C2 working group on Codes and Cryptography

8.3. European Initiatives

8.3.1. FP7 Projects

Program: FP7-ICT-2011-7
Project acronym: Flextiles
Coordinator: Thales

Other partners: Thales (FR), URI (FR), KIT (GE), TU/e (NL), CSEM (SW), CEA LETI (FR), Sundance (UK)

Project title: Self Adaptive Heterogeneous Manycore Based on Flexible Tiles

Abstract: A major challenge in computing is to leverage multi-core technology to develop energy-efficient high performance systems. This is critical for embedded systems with a very limited energy budget as well as for supercomputers in terms of sustainability. Moreover the efficient programming of multi-core architectures, as we move towards manycores with more than a thousand cores predicted by 2020, remains an unresolved issue. The FlexTiles project will define and develop an energy-efficient yet programmable heterogeneous manycore platform with self-adaptive capabilities. The manycore will be associated with an innovative virtualisation layer and a dedicated tool-flow to improve programming efficiency, reduce the impact on time to market and reduce the development cost by 20 to 50%. FlexTiles will raise the accessibility of the manycore technology to industry - from small SMEs to large companies - thanks to its programming efficiency and its ability to adapt to the targeted domain using embedded reconfigurable technologies.
Program: FP7-ICT-2011-7
Project acronym: Alma
Project title: Architecture oriented parallelization for high performance embedded Multicore systems using scilAb
Coordinator: KIT
Other partners: KIT (GE), UR1 (FR), Recore Systems (NL), Univ. of Peloponnese (GR), TEI-MES (GR), Intracom SA (GR), Fraunhofer (GE)
Abstract: The mapping process of high performance embedded applications to today’s multiprocessor system on chip devices suffers from a complex toolchain and programming process. The problem here is the expression of parallelism with a pure imperative programming language which is commonly C. This traditional approach limits the mapping, partitioning and the generation of optimized parallel code, and consequently the achievable performance and power consumption of applications from different domains. The Architecture oriented parallelization for high performance embedded Multicore systems using scilAb (ALMA) project aims to bridge these hurdles through the introduction and exploitation of a Scilab-based toolchain which enables the efficient mapping of applications on multiprocessor platforms from high level of abstraction. This holistic solution of the toolchain allows the complexity of both the application and the architecture to be hidden, which leads to a better acceptance, reduced development cost and shorter time-to-market. Driven by the technology restrictions in chip design, the end of Moore’s law and an unavoidable increasing request of computing performance, ALMA is a fundamental step forward in the necessary introduction of novel computing paradigms and methodologies. ALMA helps to strengthen the position of the EU in the world market of multiprocessor targeted software toolchains. The challenging research will be achieved by the unique ALMA consortium which brings together industry and academia. High class partners from industry such as Recore and Intracom, will contribute their expertise in reconfigurable hardware technology for multi-core systems-on-chip, software development tools and real world applications. The academic partners will contribute their outstanding expertise in reconfigurable computing and compilation tools development.

8.3.2. Collaborations in European Programs, except FP7

Program: ITEA2
Project acronym: GEODES
Project title: Global Energy Optimization for Distributed Embedded Systems
Coordinator: Thales
Other partners: Thales (FR, IT, NL), Sensaris (FR), CNRS (LEAT and IRISA) (FR), CETMEF/MARTEC (FR), Infineon (AU), Thomson (FR), TUV (AU), UAEQ (IT), Phillips (NL), Organo (AU), TI-WMC (NL)
Abstract: The GEODES project will provide design techniques, embedded software and accompanying tools needed to face the challenge of allowing long power-autonomy of features rich and connected embedded systems, which are becoming pervasive and whose usage is significantly rising. It approaches this challenge by considering all system levels, and notably emphasizes the distributed system view. GEODES is an ITEA2 project which involves partners from France, Austria, Italy and the Netherlands. In GEODES Cairn will provide to partners the PowWow very power sensor platform including reconfigurable hardware accelerators. CAIRN will also contribute on link and MAC layers strategies to a global optimization of the energy, and define and optimize advanced signal processing, error detection and correction and medium access (MAC) techniques in order to reduce the transmit power as well as the useless listening of the communication media. In particular, the case of cooperative strategies like cooperative MIMO or relaying techniques will be investigated.
8.3.3. **Major European Organizations with which Cairn has followed Collaborations**

- **Imec (Belgium)**
  Scenario-based fixed-point data format refinement to enable energy-scalable of Software Defined Radios (SDR)

- University of Erlangen-Nuremberg and Dresden University of Technology (Germany)
  Massively parallel embedded reconfigurable architectures and on dynamic reconfiguration optimisation in the mesh fabric

- University of Paderborn (Germany)
  Spatio-temporal scheduling for reconfigurable systems

- Lund University (Sweden)
  Constraints programming approach application in the reconfigurable data-paths synthesis flow

- Computer Vision and Robotic Group of the Institute for Informatics and Applications at the University of Girona (Spain)
  Parallel architectures for vision algorithms applied to underwater robot

- University of Eindhoven (Netherlands)
  Reconfigurable data-path synthesis

- University of Leiden (Netherlands)
  Parallel architecture synthesis

- Code and Cryptography group of University College Cork (Ireland)
  Arithmetic operators for cryptography

- Ecole Polytechnique Fédérale de Lausanne - EPFL (Switzerland)
  Optimization of systems using fixed-point arithmetic

- Technical University of Madrid - UPM (Spain)
  Optimization of systems using fixed-point arithmetic

- Technical University of Tampere, University of Oulu (Finland)
  Reconfigurable Video Coding

  Thomas Chabrier spent four months in the group of Prof. William P. Marnane at University College Cork, Ireland, from June.

8.4. **International Initiatives**

8.4.1. **INRIA Associate Teams**

8.4.1.1. **LRS: Loop unRolling Stones**

  - **Title:** Loop unRolling Stones: compiling in the polyhedral model
  - **INRIA principal investigator:** Steven Derrien
  - **International Partner:**
Institution: Colorado State University (United States)
Laboratory: Mélange Group

Duration: 2010 - 2012

Abstract: The goal of the team is twofold: (i) Propose new methodologies and algorithms to tackle some of the open problems in automatic parallelization and high level hardware synthesis from nested loop specifications. In particular, we would like to address the problem of parallelization of complex bioinformatics algorithms based of sophisticated dynamic programming algorithms, for which we would like to propose efficient parallelization schemes for both FPGAs (Field Programmable Gate Arrays) and GPUs (Graphical Processing Units). (ii) Provide a common open software infrastructure based on (modern/cutting edge) software engineering techniques (Model Driven Software Development) so as to help researchers prototyping new ideas and concept in the domain of optimizing compilers. Our goal being to be able to make our in-house software completely interoperable. As far as the second point is concerned, the CAIRN group at IRISA already has a strong commitment in using Model Driven Software Design technique and has set up a very fruitful collaboration with the Triskell EPI in Rennes. This is not yet the case of the Mélange group, however we expect to leverage on another Associate Team (the MoCAa EA) which also involves groups from CSU (Software Insurance Lab) and IRISA (Triskell group) to strengthen the connections on the CSU side.

8.4.2. INRIA International Partners

Los Alamos National Laboratory (USA)
Reconfigurable architectures for scientific processing

LRTS laboratory, Laval University in Québec (Canada)
Architectures for MIMO systems, Wireless Sensor Networks, INRIA Associate Team (2006-2008)

LSSI laboratory, Québec University in Trois-Rivières (Canada)
Design of architectures for digital filters and mobile communications

Computer Science Department, Colorado State University in Fort-Collins (USA)
Loop parallelization, development of high-level synthesis tools, INRIA Associate Team (2010-2012)

University of Adelaide (Australia)
Arithmetic operators

University of Queensland (Australia)
Reconfigurable architectures for scientific processing

University of California, Riverside (USA)
Optimized image processing applications synthesis

VLSI CAD lab, Electrical and Computer Engineering Department, University of Massachusetts at Amherst (USA)
CAD tools for arithmetic datapath synthesis and optimization

University of Douala, University of Yaoundé and University of Dschang (Cameroun)
Models and tools for parallelization, SARIMA GIS for the development of research laboratories in Mathematics and Computer Science in Africa

ENIT, Univ. Tunis (Tunisia)
Architectures for mobile communications

Steven Derrien spent two months in the group of Professor Sanjay Rajopdahye at Colorado State University, US, in May and June.

8.5. Exterior research visitors

Prof. Gabriel Caffarena (University CEU-San Pablo, Madrid) for one week in June.
PhD Student Nabil Ghanmy (University of Sfax, Tunisia) for one month in September.
Prof. Sébastien Roy for one month and a half in June.
Dr. Nicolas Veyrat-Charvillon (Crypto Group from the Université Catholique de Louvain, Belgium for 4 days in May-June.
PhD Student Tomofumi Yuki (Colorado State University, USA) for two months in November and December.
7. Partnerships and Cooperations

7.1. National Initiatives

Philippe Clauss, Alain Ketterlin and Vincent Loechner are involved in the proposition of an INRIA Large Wingspan Project (*Action d’Envergure Nationale*) entitled “Software for multicores and hardware accelerators” and regrouping several french teams doing researches in compilers, parallel computing and program optimization. Philippe Clauss shares the head of the project with Gilles Muller of the INRIA REGAL team. A new version of the project will be submitted to INRIA at the end of 2011.

7.2. International Initiatives

7.2.1. INRIA Associate Teams

7.2.1.1. ANCOME

Title: Memory and applications memory behavior

INRIA principal investigator: Philippe Clauss

International Partner:

- Institution: Universidad de Buenos Aires (Argentina)
- Laboratory: Departamento de Computacion, Facultad de Ciencias Exactas y Naturales

Duration: 2011 - 2013


This associate team focuses on developing original methods for the analysis of programs memory behavior, in particular in the context of applications using dynamic memory allocation. The proposed approaches consists of analyzing and modeling the runtime behavior, where extracted properties are then verified thanks to static analysis processes. Thus pure static approaches limits are overpassed. Further, the case of multi-threaded applications run on multi-core architectures is studied in order to elaborate and extend our analysis techniques and to extract properties specific to this context. The issues are mainly concerned with the conception of real-time applications using dynamic memory allocation.

7.2.2. INRIA International Partners

Rachid Seghir, researcher and teacher at the University of Batna, Algeria, works in close collaboration with Vincent Loechner. He is the co-author of the ZPolyTrans software and of a forthcoming paper in the journal ACM Transactions on Architecture and Code Optimization [13].

Benoît Meister, Managing Engineer at Reservoir Labs, New York, USA, has collaborated with Vincent Loechner and Rachid Seghir on a forthcoming publication [13].

Jean Christophe Beyler, Senior HPC Engineer at Intel and in the International Exascale project, University of Versailles, France, is experimenting energy saving strategies using the VMAD framework of the CAMUS team.

7.2.3. Visits of International Scientists

7.2.3.1. Visits

Sergio Yovine (from Jun 6 2011 until Jun 12 2011)
Institution: Universidad de Buenos Aires (Argentina), EA INRIA Ancome

Diego Garbervetsky (from Apr 1 2011 until Apr 10 2011 and from Aug 1 2011 until Sept 2 2011)
Institution: Universidad de Buenos Aires (Argentina), EA INRIA Ancome

7.2.3.2. Internships

Luis Mastrangelo (from Mar 2011 until Aug 2011)
Subject: A Virtual Machine for Automatic Program Parallelization
Institution: Universidad de Buenos Aires (Argentina)

Bruno Cuervo Parrino (from May 2011 until Oct 2011)
Subject: Formalizing a new validation mechanism under assumptions for speculative parallelism
Institution: Universidad de Buenos Aires (Argentina)

Jose Cacherosky (from Jul 2011 until Dec 2011)
Subject: Dynamic dependence profiling for Java
Institution: Universidad de Buenos Aires (Argentina)

7.2.4. Participation In International Programs

The CAMUS team is associated to the CNRS-CONICET Associated International Laboratory France-
Argentina INFINIS\(^{10}\) (INformatique Fondamentale, logIque, laNgages, vérification et Systèmes) inaugurated
in December 2011.

\(^{10}\) https://dri-dae.cnrs-dir.fr/spip.php?article3009
7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Function field sieve: implementation and hardware acceleration

Participants: Jérémie Detrey [contact], Pierrick Gaudry, Hamza Jeljeli, Emmanuel Thomé.

The team has obtained for the year 2012 a financial support from the Région Lorraine and INRIA for a project focusing on the hardware implementation and acceleration of the function field sieve (FFS).

The FFS algorithm is currently the best known method to compute discrete logarithms in small-characteristic finite fields, such as may occur in pairing-based cryptosystems. Its study is therefore crucial to accurately assess the key-lengths which such cryptosystems should use. More precisely, this project aims at quantifying how much this algorithm can benefit from recent hardware technologies such as GPUs or CPU-embedded FPGAs, and how this might impact current key length recommendations.

7.2. National Initiatives

7.2.1. ANR DEMOTIS (Collaborative Analysis, Evaluation and Modelling of Health Information Technology)

Participant: Marion Videau.

The project from “programme ARPEGE” involves three INRIA project-teams as a single partner (SMIS, SECRET and CARAMEL) together with colleagues from CECOJI (CNRS) and the company Sopinspace. It has been running from January 2009 and will continue until the beginning of 2012.

The project experiments new methods for the multidisciplinary design of large information systems that have to take into account legal, social and technical constraints. Its main field of application is personal health information systems.

7.2.2. ANR CHIC (Courbes Hyperelliptiques, Isogénies, Comptage)

Participants: Gaëtan Bisson, Romain Cosset, Pierrick Gaudry, Sorina Ionica, Pascal Molin, Emmanuel Thomé [contact].

The team has obtained a financial support from the ANR (“programme blanc”) for a project, common with colleagues from IRMAR (Rennes) and IML (Marseille). The ANR CHIC grant covers the period 09/2009 to 08/2012. The purpose of this ANR project is the study of several aspects of curves in genus 2, with a very strong focus on the computation of explicit isogenies between Jacobians.

This ANR project has been an important source of motivation for both permanent researchers and PhD students, giving notably PhD students the opportunity to meet interested colleagues on a regular basis. In 2011, a server with a huge large of central memory has been bought, to help with CHIC-related experiments. Two PhD thesis were defended (Bisson and Cosset) on the topic.

7.3. European Initiatives

7.3.1. PHC application with EPFL

The team obtained a PHC Germaine de Staël grant in collaboration with the LACAL team from EPFL (Lausanne, Switzerland), in 2011. The grant has been renewed for 2012. This collaboration focuses on integer factorization and discrete logarithms.
8. Partnerships and Cooperations

8.1. National Initiatives

- ANR Complice
- Project CyS of GIS 3SGS on smartphone forensics.

We have active collaborations with:

- Alexander Shen (LIF),
- Laurent Bienvenu (LIAMFA),
- Florian Deloup came in our group for six months as a CNRS researcher.

8.2. European Initiatives

8.2.1. FP7 Project

8.2.1.1. FI-WARE

Title: Morphus
Type: COOPERATION (ICT)
Defi: PPP FI: Technology Foundation: Future Internet Core Platform
Instrument: Integrated Project (IP)
Duration: May 2011 - April 2014
Coordinator: Telefonica (Spain)
Others partners: Thales, SAP, INRIA
See also: http://www.fi-ware.eu/
Abstract: FI-W ARE will deliver a novel service infrastructure, building upon elements (called Generic Enablers) which offer reusable and commonly shared functions making it easier to develop Future Internet Applications in multiple sectors. This infrastructure will bring significant and quantifiable improvements in the performance, reliability and production costs linked to Internet Applications building a true foundation for the Future Internet.

8.2.2. Major European Organizations with which Carte has followed Collaborations

Stefano Galatolo (Università di Pisa),
Daniel Graça (University of Faro),
Georg Moser (University of Innsbruck),
Klaus Weihrauch (FernUniversität Hagen).

8.3. International Initiatives

- ARC CaCO3 (France-Egypt), http://carte.loria.fr/index.php?option=com_content&view=article&id=63&Itemid=77

8.3.1. INRIA Associate Teams

8.3.1.1. COMPUTR
Title: COntinuous tiMe comPUTations, computation on the Reals
INRIA principal investigator: Emmanuel Hainry
International Partner:

  Institution: Instituto de Telecomunicações (Portugal)
  Laboratory: Security and Quantum Information Group

Duration: 2009 - 2011
See also: http://carte.loria.fr/index.php?option=com_content&view=article&id=60&Itemid=74

8.3.1.2. CRISTAL

Title: Resource Control by Semantic Interpretations and Linear Proof Theory
INRIA principal investigator: Romain Péchoux
International Partner:

  Institution: Universita degli Studi di Torino (Italy)
  Laboratory: Dipartimento di informatica

Duration: 2010 - 2012
See also: http://carte.loria.fr/index.php?option=com_content&view=article&id=61&Itemid=75

8.3.2. INRIA International Partners

We have active collaboration with:
- Peter Gács (Boston University),
- Cristóbal Rojas (Toronto),
- José Fernandez (Montreal),

We also start some collaborations with Dawn Song at Berkeley.

8.3.3. Visits of International Scientists

8.3.3.1. Internship

- Daniel Leivant (Indiana University, invited for six months)
- John Case (University of Delaware), http://www.cis.udel.edu/~case/
- Walid Gomaa (University of Cairo), http://www.alexeng.edu.eg/~wgomaa/
7. Partnerships and Cooperations

7.1. European Initiatives

- **ECRYPT-II: Network of Excellence in Cryptology.**
  From August 2008 to July 2012.
  *There are three virtual labs that focus on the following core research areas: symmetric key algorithms (STVL), public key algorithms and protocols (MAYA), and secure and efficient implementations (VAMPIRE).*
  ENS/INRIA/CASCADE leads the MAYA virtual lab.

- **ERC Starting Grant: LATTICE.**
  Oded Regev (2008 – 2013)

- **SecFuNet: Security for Future Networks.**
  From July 2011 to December 2013

7.2. Grants

- **Chaire ENS – France Télécom pour la sécurité des réseaux de télécommunications.**
  From January 2006 to December 2012.

- **Fondation EADS Grant.**

- **Donation of Tilera multicore cluster (512 core, 64 bits each) by Tilera.**
  This supercomputer allows the team to experiment various cryptanalysis and simulations. The machine was installed at ENS for the team, in recognition of the team’s cryptanalytic and research achievements.

7.3. Exterior Research Visitors

- Zvika Brakerski – Weizmann Institute, Israel
- Vincent Cheval – ENS Cachan, France
- Angelo De Caro – Univ. Salerno, Italy
- Karina M. Magalhães – University of Campinas, Brazil
- Petros Mol – UC San Diego, USA
- Takashi Nishide – Kyushu University, Japan
- Chris Peikert – Georgia Tech , USA
- Adi Shamir – Weizmann Institute, Israel
8. Partnerships and Cooperations

8.1. International Grants

- French-Tunisian project on *Security Policies and Configurations of Firewalls: Compilation and Automated Verification*. We collaborate with SupCom Tunis and the INRIA project-team Dahu in the context of STIC-Tunisia.

8.2. National Grants

- ANR SESUR AVOTÉ—*Formal Analysis of Electronic-Voting protocols*, duration: 4 years, started in January 2008. Electronic voting promises the possibility of a convenient, efficient and secure facility for recording and tallying votes. However, the convenience of electronic elections comes with a risk of large-scale fraud. The AVOTÉ project aims at proposing techniques for formally analyzing e-voting protocols. Cassis is the coordinator of the project. Partners are: France Telecom Lannion, LSV Cachan, Verimag Grenoble.

- ANR DECERT — *Deduction and Certification*, coordinated by Thomas Jensen (IRISA). This project focuses on the design of decision procedures, in particular for fragments of arithmetic, and their integration into larger verification systems, including skeptical proof assistants. Partners are: IRISA Rennes, LRI Orsay, INRIA Sophia, Systerel and CEA. From INRIA Nancy, the teams Veridis and Cassis are involved. This project started in January 2009 for three years.

- ANR TASCCC *Test Automatique basé sur des Scénarios et Critères Communs – Automated Testing based on Scenarios and Common Criteria*, duration: 3 years, starting in December 2009. The project aims at completing the model-based testing process initiated in the POSE project, using scenarios to specify the test cases that have to be generated by model animation. The goal is here to provide an automated means for generating the scenarios from a given set of properties. The overall objective is to ease the Common Criteria evaluation of secure softwares. Partners: Trusted Labs (leader), Gemalto, LIG, LIFC, Supelec, Smartesting, and Serma Technologies. The local coordinator is Frédéric Dadeau.

- ANR PROSE *Protocoles de sécurité: modèle formel, modèle calculatoire, et implémentations — Security protocols : formal model, computational model, and implementations*, duration: 4 years, started in December 2010. The goal of the project is to increase the confidence in security protocols, and in order to reach this goal, provide security proofs at three levels: (i) the symbolic level, in which messages are terms, (ii) the computational level, in which messages are bitstrings, and (iii) the implementation level: the program itself. Partners are Cascade Paris (leader), LSV Cachan, Cassis and Verimag Grenoble.

- ANR STREAMS *Solution for Peer-to-peer Real-Time Social Web*, duration: 3 years, starting in October 2010. This project proposes to design peer-to-peer solutions that offer underlying services required by real-time social web applications and that eliminate the disadvantages of centralised architectures. There exists a tension between sharing data with friends in a social network deployed in an open peer-to-peer network and ensuring privacy. One of the most challenging issues in social applications is how to balance collaboration with access control to shared objects. This project aims at providing theoretical solutions to these challenges as well as practical experimentations. Partners are: LORIA Score team (leader), INRIA project-teams Regal, Asap, Cassis, and XWiki.
- **ANR FREC** *Frontiers of recognizability*, duration: 4 years, starting in October 2010. The goal of this project is to be a driving force behind the extension of the algebraic theory of regular languages made possible by recent advances. Four directions will be investigated: tree languages, λ-terms, automata with counters, algebraic and topological tools. Partners are LABRI (leader), LIAFA (University Paris 7). Pierre-Cyrille Héam is a member of this project, attached to Paris 7 for administrative facilities.

- **FUI SQUASH** *Software QUality ASSurance enHacement*, duration: 2 years, starting in April 2011. This project aims to industrialize and to structure software testing activities. The project can be provide methodology and tools framework based on open source components.

- **ANR OSEP** *Online and offline model-based testing of SEcurity Properties*, duration: 2 years, starting in December 2011. The goal of this project is to test the security with online and offline model-based testing approach. The main element of project is to capitalize or to reuse a test model with different testing method. So, we develop new algorithms to allow online testing. This approach must be compatible with our previous offline approach to increase the number of artefacts that can be shared. This approach can be applied to the components of security and the Software Radio. Partners are DGA and Smartesting.

- **Collaborative Research Initiative INRIA, ARC ACCESS.** This project is concerned with the security and access control for Web data exchange, in the context of Web applications and Web services. We aim at defining automatic verification methods for checking properties of access control policies (ACP) for XML, like consistency or secrecy. Partners are: INRIA project-teams Dahu, Mostrare and Cassis.

### 8.3. International Collaborations

- In the area of automated test generation from a formal model, we have an active collaboration with Dr Mark Utting from the Formal Method group from the University of Waikato. This cooperation is supported by the France-New-Zealand scientific program.

- In the area of business applications, we have been working on the may-/must semantics of coloured work-flow Petri nets with the Information System group of Professor W. van der Aalst from the Technical University of Eindhoven, The Netherlands.

- In the area of security protocols penetration testing, we have started a collaboration with Karlsruhe Institute of Technology (Germany) led by Prof. Alexander Pretschner. This collaboration is mainly supported by KIT, in the context of the FP7 SPACIOS project.

### 8.4. Individual Involvement

**F. Bouquet:** PC member of Modevva’11 (Model-Driven Engineering, Verification, And Validation), ICST 2012. PC Chair of the 1st International Workshop on Verification and Validation of Complex System (V2CS’2011) Head of the Online teaching department of Computer science in the University of Franche-Comté since Sept. 2011. Expert for Luxembourg National Research Fund.

**V. Cortier:** Principal Investigator of the ERC Starting Grant ProSecure (2011-2016); coordinator of the ANR SESUR AVOTÉ (started in Jan. 2008); PC member of ESORICS 2011 (16th European Symposium on Research in Computer Security), MFPS 2011 (27th Conference on the Mathematical Foundations of Programming Semantics), FC 2011 (15th International Conference on Financial Cryptography and Data Security), RTA 2011 (22nd International Conference on Rewriting Techniques and Applications); member of selection committees: INRIA Bordeaux (CR position), Caen University (Full Professor); member of the Evaluation Committee of the INRIA since Sept. 2008.

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A. Imine: PC Member of the 22nd International Conference on Database and Expert Systems Applications (DEXA’2011), the 8th Colloquium on Optimization and Information Systems (COSI’2011) and the 3rd International Conference on Computer Science and its Applications (CIIA’2011). Member of the scientific committee of InterOP (Interest Group on Enterprise Systems Interoperability).

O. Kouchnarenko: Director of the LIFC Laboratoire d’informatique de Franche Comté; Member of the “Comité de direction” of the FEMTO-ST Institut; Member of the selection committees at the UFC; PC member of “International Workshop on Abstractions for Petri Nets and Other Models of Concurrency”, APNOC’11.


C. Ringeissen: PC member of ProCoS’11 (Frontiers of Combining Systems) and SoICT 2011 (International Symposium on Information and Communication Technology). Member of the COST Committee of INRIA since Oct. 2011 (working group “Actions Incitatives”).


L. Vigneron: Member of the FTP steering committee; Member of the IFIP Working Group 1.6 on Rewriting; Webmaster of the site Rewriting Home Page and of the RTA conference Web site. Member of the “Conseil de laboratoire” of LORIA. Director of the “Licence-Master MIAGE (Méthodes Informatiques Appliquées à la Gestion des Entreprises)” in the University of Nancy 2.

P.-C. Héam: Co-head of the FORWAL working group of GDR-GPL-CNRS. Director of the “Licence Informatique” in the University of Franche-Comté until Sept. 2011.

8.5. Visits of Foreign Researchers

Adel Bouhoula (SupCom Tunis, Tunisie) has visited Cassis (July 14 - July 21) to work on firewall policies.

Chris Lynch (University of Clarkson, USA) has visited Cassis (August 8 - August 15) to work on automated deduction.

Paliath Narendran (University of Albany, USA) has visited Cassis (August 19 - August 25) to work on unification algorithms for security protocol analysis.

Olivier Pereira (Université Catholique de Louvain, Belgium) has visited Cassis to work on developments of Helios (November 28).

Valerio Senni (University of Roma “Tor Vergata”, Italy) has visited Cassis (30th September - 3rd October) for a seminar and to work on structured data generation for testing.

Bogdan Warinschi (University of Bristol, UK) has visited Cassis three times to work on privacy for voting protocols and combination techniques for soundness results of symbolic model (January 17-19, June 20 - 24, and November 20 - 30).
8.6. Visits of Team Members

Olga Kouchnarenko has visited Natalia Sidorova (Eindhoven Univ. of Technologies, Netherlands) to work on the may-/exit-semantics of workflow Petri nets and on their configurations to ensure weak termination (November 6 - 13).

F. Dadeau and P.-C. Héam have visited Alexander Pretschner (Karlsruhe Institute of Technology) to work on testing security protocols (August 25-26).
7. Partnerships and Cooperations

7.1. International Initiatives

7.1.1. INRIA International Partners

Since three years, we have developed a long-term collaboration with Yahia Lebbah, from University of Oran, Algeria. This collaboration has been fruitful with several publications, the last one being [19] and the INRIA International programme support DGRI. This fund permitted us to visit each other’s group in 2011 with the 1-month visit of N. Lazaar to the University of Oran and the 1-week visit of Y. Lebbah to INRIA Rennes in Dec. 2011.
7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR project PANDA: “Analyse du Parallélisme et de la Distribution”

This project is financed by the ANR, for the years 2009-2011. The partners involved are:

- EPIs Comète and Parsifal at INRIA Saclay. Responsible: Catuscia Palamidessi
- CEA Saclay. Responsible: Emmanuel Haucourt
- Pôle Parisien. Responsible: Damiano Mazza
- Pôle Méditerranéen. Responsible: Emmanuel Godard
- Airbus. Responsible: Jean Souyris.

7.1.2. ANR project CPP: Confidence, Proofs and Probabilities

This project is financed by the ANR, for the years 2009-2011. The partners involved are:

- LSV. Responsible: Jean Goubault-Larrecq
- EPIs Comète and Parsifal at INRIA Saclay. Responsible: Catuscia Palamidessi
- CEA LIST. Responsible: Olivier Bouissou
- Supelec SSE. Responsible: Gilles Fleury
- Supelec L2S. Responsible: Michel Kieffer

7.2. International Initiatives

7.2.1. DRI Equipe Associée PRINTEMPS

PRINTEMPS (PRobability and INformation Theory for Modeling Privacy and Secrecy) focuses on the applications of Information Theory to security. We are particularly interested in studying the interactions between Concurrency and Information Theory.

This project has started in January 2006 and includes the following sites:

- INRIA Futurs. Responsible: C. Palamidessi
- McGill University, Canada. Responsible: P. Panangaden

Home page: [http://www.lix.polytechnique.fr/comete/Projects/Printemps/](http://www.lix.polytechnique.fr/comete/Projects/Printemps/)

7.2.1.1. International Partners

- Moreno Falaschi, Dipartimento di Scienze Matematiche e Informatiche, Università di Siena, Italy.
- Camillo Rueda and Carlos Olarte, Pontificia Universidad Javeriana, Colombia.
- Geoffrey Smith, School of Computing and Information Sciences, Florida International University, USA
- Vladimiro Sassone, School of Electronics and Computer Science University of Southampton, United Kingdom.

7.3. Exterior research visitors

7.3.1. Visits of International Scientists
- Geoffrey Smith, Professor at the Florida Florida International University, USA. He visited for four months, from 26/8/2011 until 23/12/2011.
- Moreno Falaschi, professor at the Università di Siena, Italy. He visited for one month, from 1/11/2011 till 30/11/2011.
- Vladimiro Sassone, professor at the University of Southampton, United Kingdom, Italy. He visited for one month, from 1/12/2011 till 31/12/2011.

### 7.3.2. Internship

- Marco Stronati, master student at the Università di Pisa, Italy. He is visiting for six months, from 1/10/2011 till 31/3/2012. He is doing his master thesis under the co-supervision of Giorgio Levi (Univ. di Pisa) and Catuscia Palamidessi.
- Lili Xu, PhD student at the Academy of Science of Beijing, China. She is visiting for nine months, from 15/10/2011 until 15/7/2012. She is doing her PhD thesis under the co-supervision of Huimin Li (Ch. Academy of Science, Beijing) and Catuscia Palamidessi.
8. Partnerships and Cooperations

8.1. National Initiatives

- The french compiler community is now well identified and is visible through its web-page http://compilation.gforge.inria.fr/. The “journées françaises de la compilation”, initiated in 2010 and officially animated by Fabrice Rastello and Laure Gonord, are now well-established as a biannual event. Their local organization is handled alternately by the different research teams (Lyon in summer 2010, Aussois in Winter 2010, Dinard in Spring 2011, St Hippolyte in Autumn 2011).

- Christophe Alias and Paul Feautrier have been active participants in an effort to structure the french high-level synthesis community, including both actors from academia (TIMA, IRISA, LaStIC, ASIM) and industry (Thales, Bull). The aim of this effort was to submit an ANR proposal for the Arpege initiative. A first version was submitted in 2010, but was rejected mostly on the ground that the project leader should have been from industry rather than academia. A revised proposal, under the leadership of the Magillem company, was submitted in March 2011 and rejected too. It seems evident in retrospect that the HLS community has yet to find a clearer balance between new research and industrial development, and that a new submission must wait for a more mature approach.

8.2. Participation in International Programs

- Fabrice Rastello has obtained a FAPEMIG-INRIA (Brazil-France) funding to collaborate with Mariza A. S. Bigonha, Fernando M. Q. Pereira, and Roberto S. Bigonha from the Federal University of Mina Gerais (UFMG) in Brazil. The work on static single information form described in Section 6.7, and the work on register allocation to handle aliasing described in Section 6.5 are part of this collaboration.

- From July 2010 till July 2011, Fabrice Rastello was in a sabbatical year at Colorado State University within the group of Sanjay Rajopadhye, and in connection with the PathScale compiler company.

8.3. Informal Contacts

- Compsys has regular contacts with Sebastian Hack at Saarland University (Saarbrücken, Germany), Philip Brisk at University of California, Riverside (Riverside, USA), and Benoît Dupont de Dinechin (Kalray, Grenoble) on back-end code optimizations.

- Compsys has regular contacts with P. Sadayappan (Ohio State University), J. (Ram) Ramanujam (Louisiana State University), and Sanjay Rajopadhye (Colorado State University), on polyhedral code transformations. Fabrice Rastello was in sabbatical in 2010-2011 in Sanjay Rajopadhye’s group. Christophe Alias is co-advising a PhD with Sanjay Rajopadhye, with an agreement to be signed between ENS-Lyon and Colorado State University.

- In France, Compsys is particularly linked with researchers such as Albert Cohen (Parkas team, Inria), Steven Derrien (Cairn team, Inria), Alain Greiner (LIP6, Paris), Alain Ketterlin (Camus team, Inria), Benoît Dupont de Dinechin (Kalray), Christophe Guillon (STMicroelectronics).

- Compsys, as some other Inria projects, is involved in the network of excellence HiPEAC (High-Performance Embedded Architecture and Compilation, http://www.hipeac.net/). Compsys is also a (distant) partner of the network of excellence Artist2 to keep an eye on the developments of MPSoC.
• Florian Brandner is collaborating with the group of Andreas Krall at the Vienna University of Technology on topics related to the processor description language xADL and on compilation for explicitly parallel processors (EPICOpt, http://www.complang.tuwien.ac.at/epicopt/). He is additionally working with Martin Schöberl from the Technical University of Denmark (DTU) on topics evolving around time-predictable computing.

• Alain Darte is in contact with Yann Orlarey from the Grame team (Lyon, “Centre National de Création Musicale”). They co-advice a Master 1 internship on some features in the development of Faust, a compiled language for real-time audio signal processing.

8.4. Visits of Research Scientists

Since Autumn 2010, several researchers visited Compsys and gave talks in our working groups.

• Amir Ben Amram (Tel Aviv University, Israël).
• Sebastian Hack (Saarland University, Germany).
• Andreas Krall and Gergő Barany (Vienna University, Austria).
• J. Ramanujam (Baton Rouge University, Louisiana)
• Antoniu Pop (Ecole des Mines, Paris).
• Benoît Dupont de Dinechin (Kalray, Grenoble).
• Alain Ketterlin (Camus Inria team, Strasbourg).
• Albert Cohen (Parkas Inria team, Paris).

8.5. Internships

In Spring 2011, three internships were advised in Compsys.

• Guillaume Andrieu (Polytech’Lille engineering school, Master level): termination of big programs.
• Alexandre Isoard (ENS-Lyon, M1 Master level): retiming for Faust.
• François Gindraud (ENS-Lyon, M1 Master level): $\psi$-SSA, gated-SSA, and variants.
8. Partnerships and Cooperations

8.1. National Initiatives

- ANR Investissement Avenir Iceberg project (2011-2016) coordinated by Grégory Batt, with Pascal Hersen (MSC lab, Paris Diderot Univ./CNRS), Reiner Veitia (Institut Jacques Monod, Paris Diderot Univ./CNRS), Olivier Gandrillon (BM2A lab, Lyon Univ./CNRS), Cedric Lhoussaine (LIFL/CNRS), and Jean Krivine (PPS lab, Paris Diderot Univ./CNRS).


- ANR Cosinus Syne2arti project (2010-2013) coordinated by Grégory Batt, with Oded Maler, CNRS Verimag, Dirk Drasdo, EPI Bang, and Ron Weiss, MIT.


- GENCI (2009-) attribution of 300000 computation hours per year on the cluster SGI of 10000 processors at CINES, Montpellier.

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7

Program: EraNet SYsBio
Project acronym: C5Sys
Project title: Circadian and cell cycle clock systems in cancer
Duration: mars 2010 - mars 2013
Coordinator: Francis Lévi, INSERM Hopital Paul Brousse, Villejuif, France and David Rand, Warwick Systems Biology, UK,
Other partners: EPI BANG, Erasmus University Medical Center, Rotterdam, University College London, UK, CNRS Nice, and L2S, Orsay.
Abstract: Mammalian cells are endowed with biological oscillators which time their activities. The circadian clock (circa, about; dies, day) generates a 24-hour rhythm which controls both cellular metabolism and cell division. The cell division cycle is an oscillator which times DNA synthesis, mitosis, and related apoptosis and DNA repair. Our understanding of the molecular mechanisms at work in both oscillators has greatly improved. In sharp contrast, little is known about how these two crucial oscillators interact, and how these interactions affect cellular proliferation in normal or cancer cells. On the one hand, the disruption of circadian clocks impairs cell physiology and quality of life. On the other hand, disruption of cell cycle, DNA repair or apoptosis impacts on cell and organism survival. Experimental and clinical data show that circadian disruption accelerates malignant proliferation, and that DNA damage can reset the circadian clock. The central question addressed is how interactions between the circadian clock and cell cycle affect cellular proliferation and genotoxic sensitivity in normal and cancer cells, and how this knowledge translates into new prevention or therapeutic applications. Seven teams in France, Netherlands and United Kingdom integrate experimental, mathematical and bioinformatic approaches, so as to develop novel cell lines, biomarker monitoring methods and mathematical tools. C5Sys triggers innovative chronotherapeutic research for human cancers and advances systems medicine for improving patient care.

8.3. International Initiatives

8.3.1. INRIA International Partners

We have tight collaborations with the Weiss lab for synthetic biology at MIT, USA, through participation in the ANR Syn2arti project coordinated by Grégory Batt, and through the joint supervision of Xavier Duportet’s PhD thesis.

We also have a starting collaboration with the Center for Systems and Control at the Delft University of Technology (The Netherlands) on developing formal probabilistic approaches for robust control of gene expression. This collaborative project is funded by the Frans/Nederlandse Academie as part of the van Gogh Programm (Coordination Alessandro Abate/Grégory Batt).

8.3.2. Visits of International Scientists

8.3.2.1. Visiting Professor

Calin Belta, Boston University, USA (2 months).

8.3.2.2. Internships

Gopalakrishnan Kumar

Subject: Stochastic model of the yeast Met3 promoter
Institution: IIT Bombay (India)

Armando Gonçalves Da Silva Junior

Subject: Generating Explanatory Traces for Rule-Based Constraint Reasoning CHR
Institution: Federal University of Pernambuco (UFPE) (Brazil)

Philip Robin

Subject: Hybrid Simulations with Events
Institution: IIT New Delhi (India)

8.3.2.3. Short visits

Xuefeng Gao, University College, Cork, Ireland,
Neda Saeedloei, University of Texas, Dallas, USA
Yaakov Setty, Weizmann Institute, Rehovot, Israel,
Szymon Stoma, Humboldt University, Berlin, Germany

8.3.3. Participation In International Programs

Program: STIC AmSud
Project acronym: TODAS
Project title: Trace Observation Driven Adaptive Solvers
Duration: janvier 2010 - décembre 2011
Coordinator: Pierre Deransart INRIA
Other partners: Eric Monfroy, UFSTM, Chile, Luis Menezes, UPE, Brazil, J. Robin, UFPE, Brazil, and F. Saubion, LERIA, U. Angers.
Abstract: The objective of the project is to define or improve self-adaptive constraint solving algorithms (Boolean, finite domains, local search or rules CHR) and their essential parameters, with an approach partly based on generic traces, to allow experimentation on different classes of solvers. At INRIA we worked in two directions: the development of a generic trace for CHR* [11], and the integration of the approach of generic trace to describe different kinds of adaptive solvers.
DART Project-Team (section vide)
ESPRESSO Project-Team

7. Partnerships and Cooperations

7.1. National Actions
Participants: Jean-Pierre Talpin, Thierry Gautier, Paul Le Guernic.

7.1.1. ONERA/Thales TORRENTS working group
Team Espresso participates to the TORRENTS working group since its inaugural seminar in 2010. TORRENTS is a federates the activities related to time-oriented embedded systems being primarily carried out in research labs in Toulouse. It is supported by the RTRA STAE foundation. TORRENTS aims at proposing a methodology for time-based design of embedded aerospace real-time systems.

http://www.irit.fr/torrents

7.2. European Actions
Participants: Thierry Gautier, Paul Le Guernic, Jean-Pierre Talpin, Eric Vecchie.

7.2.1. Network of excellence ARTIST2
The Espresso project-team participates to the Artist2 network of excellence. Detailed presentations on the aim and scope of the network can be found in the book [1] and the website http://www.artist-embedded.org/FP6 of the project. In particular, we have contributed to a survey of real-time programming languages edited by Alan Burns [42].

7.3. International collaborations
Participants: Loïc Besnard, Adnan Bouakaz, Thierry Gautier, Paul Le Guernic, Sun Ke, Jean-Pierre Talpin.

7.3.1. INRIA associate project POLYCORE
In the frame of three consecutive joint NSF-INRIA and INRIA associated project programs, together with additional funds from INRIA scientific direction, INRIA-Rennes, the University of Rennes, the ARTIST NoE, we have established a long-lasting and scientifically fruitful collaboration with the Fermat Laboratory at Virginia Tech (Pr. Sandeep Shukla) and UC San Diego (Pr. Rajesh Gupta). The collaboration started in 2002 and was prolonged until 2009 with the one-year sabbatical of Sandeep Shukla as invited professor. This collaboration resulted in the joint publication of 10 scientific books and series volumes as well as 22 international journal and conference articles. In the frame of this collaboration, we jointly created the ACM-IEEE MEMOCODE (http://www.memocode-conference.com) international symposium series as well as the FMGALS international workshop series. Finally, we jointly organized four tutorials. This series of collaborations resulted in a technology transfer of the Polychrony toolset with the launch of the project CodeSyn at Virginia Tech, funded by the US Air Force Research Laboratories (AFRL), and now employs one of our former post-doctorates, Julien Ouy.

Our collaboration is now been renewed in the frame of the 2011 INRIA Associate Project POLYCORE and extended to a key additional partner, the Embedded System Group of Pr. Klaus Schneider at TU Kaiserslautern.

Our joint project starts from an observation that can be shared with anyone how experienced with multi-threaded programming, to acknowledge the difficulty of designing and implementing such software. Resolving concurrency, synchronization, and coordination issues, and tackling the non-determinism germane in multi-threaded software is extremely difficult. Ensuring correctness with respect to the specification and deterministic behavior is however necessary for safe execution of such code on embedded architectures. It is therefore desirable to synthesize multi-threaded code from formal specifications using a provably ‘correct-by-construction’ approach.
In Europe, it has been widely claimed that the embedded software for 'fly-by-wire' was mostly automatically generated using tools based on the synchronous programming models. Unfortunately, software generated in those contexts usually operate in a time-triggered execution model. Such models are simple but way less efficient than multi-threaded software when run on multi-core processors, just because of the periodic synchronization overhead.

While time-triggered programming model simplifies code generation, our shared intuition is that multi-rate event driven execution models are much more efficiently adapted to tackle embedded software design challenges posed by forthcoming heterogeneous multi-core embedded architectures. To this aim, we plan to develop formal models, methods, algorithms and techniques for generating provably correct multi-threaded reactive real-time embedded software for mission-critical applications. For scalable modeling of larger embedded software systems, the specification formalism has to be compositional and hierarchical.

Our proposed formalism entails a model of computation (MoC) based on a multi-rate synchronous data-flow paradigm: Polychrony. It aims at combining the capabilities of Esterel/Quartz (ESG/TUKL) for correctly programming synchronous modules, with the capabilities of Polychrony (INRIA), to give high-level abstractions of complex multi-clocked networks and yet provide powerful communication and scheduling code synthesis, all combined in an application-specific modeling and programming environment, design in collaboration with Virginia Tech and the AFRL (whom we submitted the white-paper of a project proposal for funding in 2012).
FORMES Team

8. Partnerships and Cooperations

8.1. National Initiatives

- FORMES is part of the working group LTP on Languages, Types and Proofs of the GDR GPL\(^{10}\), the French research network on software engineering.
- FORMES is part of the working group LAC on Logic, Algebra and Calculus of the GDR IM\(^{11}\), the French research network on mathematics and computer science.

8.2. International Initiatives

8.2.1. Visits of International Scientists

8.2.1.1. Long-term visitors

- Jean-Jacques Lévy (INRIA, France), director of the MSR-INRIA Joint Center, visited FORMES from September 26 to November 18, gave lectures on reductions and causality.
- Pierre-Louis Curien (PPS, CNRS and University Paris 7) visited FORMES in April and May, and co-organized a working group on rewriting theory and algebra.
- Joseph Sifakis (VERIMAG, France) visited FORMES in March and October and participated to various working groups.

8.2.1.2. Short-term visitors

- Zhang Min (JAIST, Japan) gave a talk on December 20 on algebraic-based verification of a dynamic software updating system.
- Vladimir Voevodsky (IAS Princeton, USA), Fields Medal 2002, gave a talk on December 12 on univalent semantics of constructive type theories.
- Jianhua Gao (ISCAS, China) gave a talk on November 25 on the clausal presentation of theories in deduction modulo.
- Iddo Tzameret (ITCS, Tsinghua University) gave a talk on November 18 on short propositional refutations for dense random 3-CNF formulas.
- Eric Madelaine (INRIA, France) gave a talk on November 11 at Shenzhen SIAT on specification, model generation and verification of distributed applications.
- Jean-Raymond Abrial (ETH, Switzerland) gave a talk on September 9 on modeling, refining and proving with Event-B.
- Graham Steel (LSV, ENS Cachan, France) gave lectures on the security of APIs at Tsinghua University and Nokia from August 22 to August 25.
- Thomas Anberree (Nottingham University at Ningbo, China) gave a talk on June 22 on definable quotients in type theory.
- Hsu-Chun Yen (National Taiwan University) gave a talk on May 20 on two-way transducers and parametrized machines.
- Lijun Zhang (Denmark Technical University) gave a talk on May 13 on ODEs in probabilistic model checking.

\(^{10}\) http://gdr-gpl.cnrs.fr/
\(^{11}\) http://www.gdr-im.fr/
• Flemming Nielson (Denmark Technical University) gave a talk on May 13 on model checking as static analysis of modal logic.
• Christian Urban (TU Munich, Germany) gave a talk on April 29 on verifying a regular expression matcher and formal language theory.
• Zhaohui Luo (University of London, UK) visited FORMES in April and gave lectures on type theory from April 13 to April 19.
• On April 11, for the 1st Tsinghua Software Day organized by the FORMES team, we had the following talks: A journey into the semantics of programming languages, by Pierre-Louis Curien; type theory and its application, by Zhaohui Luo; advances towards the formal proof of the classification of finite groups, by Georges Gonthier; from boolean to quantitative theories of software, by Tom Henzinger.
• Joseph Sifakis (VERIMAG, France) gave a talk on March 10 on a vision for computer science: the system perspective.

8.2.2. Participation In International Programs

• SIVES\(^\text{12}\) is a French-Chinese ANR-NSFC project for 2009-2011 between INRIA FORMES, Tsinghua University and ST Microelectronics on the development of a “SImulation and Verification based platform for Embedded Systems” (coordinated by Frédéric Blanqui on the French side and Ming Gu on the Chinese side).
• Logical Frameworks is a grant from the National Science Foundation of China obtained by Jean-Pierre Jouannaud and Jianqi Li to sustain their work on the subject.

\(^{12}\) http://formes.asia/cms/sives
GALAAD Project-Team (section vide)
8. Partnerships and Cooperations

8.1. National initiatives

8.1.1. ANR U3CAT

Participant: Xavier Leroy.

The Gallium project participates in the “U3CAT” project of the Arpège programme of Agence Nationale de la Recherche. This 3.5-year action (2009-2012) is coordinated by CEA LIST and focuses on program verification tools for critical embedded C codes. We are involved in this project on issues related to memory models and formal semantics for the C language, at the interface between compilers and verification tools.

8.1.2. FNRAE Ascert

Participant: Xavier Leroy.

The “Ascert” project (2009-2011) is coordinated by David Pichardie at INRIA Rennes and funded by Fondation de Recherche pour l’Aéronautique et l’Espace. The objective of Ascert is to investigate the formal verification of static analyzers.

8.1.3. IRILL

Participants: Roberto Di Cosmo, Didier Rémy.

Roberto Di Cosmo has been working on the creation of the IRILL (Initiative d’Innovation et Recherche sur le Logiciel Libre), also known as FSRII (Free Software Research and Innovation Institute), which has the ambition of providing an attractive environment to researchers working on the new, emerging scientific issues coming from Free Software (the work on package dependencies is an archetypical example), to industry players willing to collaborate with researchers on these issues, and to educators working on improving the CS Curricula using Free and Open Source Software.

IRILL is an INRIA joint initiative with University Paris Diderot and University Pierre et Marie Curie. It was established by an agreement formally signed on November 2nd 2010, and its activity started with the IRILL Days event in October 2010. IRILL is currently hosting three major research projects (see http://www.irill.org).

8.1.4. LaFoSec

Participant: Damien Doligez.

The LaFoSec study, commissioned by ANSSI, aims at studying the security properties of functional languages, and especially of OCaml. The study is done by a consortium led by the SafeRiver company. It has produced more than 600 pages of documents. Most of these documents will be available from the ANSSI Web site (http://ssi.gouv.fr/). The study continues with the production of a prototype of a secure XML/XSD validator following the recommendations proposed in the first part of the study.

8.2. Regional initiatives

8.2.1. Digiteo Metal

Participants: François Pottier, Nicolas Pouillard.

The Metal project (2008-2011) of the Digiteo RTRA is coordinated by François Pottier. It focuses on formal foundations and static type systems for meta-programming.

8.2.2. Digiteo Hisseo

Participant: Xavier Leroy.

The Hisseo project (2008-2011) of the Digiteo RTRA is coordinated by Pascal Cuq at CEA LIST. It studies issues related to floating-point arithmetic in static analyzers and verified compilers.
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ADT CGAL-Mesh

Participants: Pierre Alliez, Mariette Yvinec, Jean-Daniel Boissonnat.

CGAL-Mesh was a two-year INRIA technological development action started in March 2009. Building upon components from CGAL, we have implemented a generic mesh generation framework for 3D domains. We primarily target applications which involve data acquired from the physical world: geology, medicine, 3D cartography and reverse engineering. We wish to establish for the whole duration of the action a close collaboration with industrial and academic partners so as to maximize the impact of the platform for a number of applications and research experiments.

- Starting date: March 2009
- Duration: 2 years

8.1.2. ANR Triangles

Participants: Olivier Devillers, Monique Teillaud.

Web site: http://www.inria.fr/sophia/geometrica/collaborations/triangles/

We lead the TRIANGLES project funded by the ANR. The project involves:

- the «Laboratoire d’InfoRmatique en Image et Systèmes d’information» (LIRIS), Lyon,
- the «Département d’informatique de l’ENS»
- the GEOMETRICA team.

Triangulations are essential in many applications, in particular for meshing and shape reconstruction. We want to develop and distribute new results for academic and industrial researchers. The goal of the project is the development of robust and effective algorithms for the manipulation of large sets of points, of moving sets of points and points in non Euclidean spaces such as periodic spaces (torus, cylinder), projective, oriented projective or hyperbolic spaces. The results obtained will be implemented in the CGAL library and will be applied to computer vision (visual envelopes, camera calibration), fluid dynamics, astronomy, computer graphics and medical applications.

In the GEOMETRICA team, Triangles is co-funding the scholarship of Pedro de Castro (with «Région PACA») and funding travel expenses and computers. Several meetings have been organized between participants, details can be found on the project’s web page.

- Starting date: November 2007
- Duration: 3 years + 6 months prolongation.

8.1.3. ANR GAIA

Participants: Jean-Daniel Boissonnat, Frédéric Chazal, David Cohen-Steiner, Arijit Ghosh.

The aim of this project is to formalize a collaboration between researchers from computational geometry, machine learning and computer vision to study distortions and in particular Bregman divergences, information theory, statistics, Riemannian geometry, and convex analysis.

The other partners of the project are the Université des Antilles et de la Guyane (R. Nock, coordinator), the Ecole Polytechnique (F. Nielsen) and the Lear project-team (C. Schmid).
- Starting date: November 2007
- Duration: 4 years

### 8.1.4. ANR GIGA

**Participants:** Pierre Alliez, Jean-Daniel Boissonnat, Frédéric Chazal, David Cohen-Steiner, Mariette Yvinec, Steve Oudot, Marc Glisse.

GIGA stands for Geometric Inference and Geometric Approximation. GIGA aims at designing mathematical models and algorithms for analyzing, representing and manipulating discretized versions of continuous shapes without losing their topological and geometric properties. By shapes, we mean sub-manifolds or compact subsets of, possibly high dimensional, Riemannian manifolds. This research project is divided into tasks which have Geometric Inference and Geometric Approximation as a common thread. Shapes can be represented in three ways: a physical representation (known only through measurements), a mathematical representation (abstract and continuous), and a computerized representation (inherently discrete). The GIGA project aims at studying the transitions from one type to the other, as well as the associated discrete data structures.

Some tasks are motivated by problems coming from data analysis, which can be found when studying data sets in high dimensional spaces. They are dedicated to the development of mathematically well-founded models and tools for the robust estimation of topological and geometric properties of data sets sampled around an unknown compact set in Euclidean spaces or around Riemannian manifolds.

Some tasks are motivated by problems coming from data generation, which can be found when studying data sets in lower dimensional spaces (Euclidean spaces of dimension 2 or 3). The proposed research activities aim at leveraging some concepts from computational geometry and harmonic forms to provide novel algorithms for generating discrete data structures either from mathematical representations (possibly deriving from an inference process) or from raw, unprocessed discrete data. We target both isotropic and anisotropic meshes, and simplicial as well as quadrangle and hexahedron meshes.

This project coordinated by GEOMETRICA also involves researchers from the INRIA team-project ABS, CNRS (Grenoble), and a representative from the industry (Dassault Systèmes).

- Starting date: October 2009.
- Duration: 4 years.

### 8.1.5. DIGITEO Chair C3TTA: Cell Complexes in Computational Topology: Theory and Applications

**Participants:** Claire Caillerie, Frédéric Chazal, David Cohen-Steiner, Marc Glisse, Steve Oudot, Amit Patel.

The primary purpose of this project is to bring about a close collaboration between the chair holder Dr Vin de Silva and Digiteo teams working on the development of topological and geometric methods in Computer Science. The research program is motivated by problems coming from the increasing need of studying and analyzing the (often huge) data sets that are now available in many scientific and economic domains. Indeed, due to the improvements of measurement devices and data storage tools, the available data about complex shapes or complex systems are growing very fast. These data being often represented as point clouds in high dimensional (or even infinite dimensional) spaces there is a considerable interest in analyzing and processing data in such spaces. Despite the high dimensionality of the ambient space, one often expects them to be located around an unknown, possibly non linear, low dimensional shape. It is then appealing to infer and analyze topological and geometric characteristics of that shape from the data. The hope is that this information will help to process more efficiently the data and to better understand the underlying complex systems from which the data are generated. In the last few years, topological and geometric approaches to obtain such information have encountered an increasing interest. The goal of this project is to bring together the complementary expertises in computational topology and geometry of the involved Digiteo teams and in applied geometry and algebraic topology of V. de Silva to develop new topological approaches to the previous mentioned domain. The project intends to develop both the theoretical and practical sides of this subject. The other partners of the project are the Ecole Polytechnique (L. Castelli-Aleardi and F. Nielsen) and the CEA (E. Goubault).
8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. CG-Learning

Title: Computational Geometric Learning  
Type: COOPERATION (ICT)  
Defi: FET Open  
Instrument: Specific Targeted Research Project (STREP)  
Duration: November 2010 - October 2013  
Coordinator: Friedrich-Schiller-Universität Jena (Germany)  
Others partners: National and Kapodistrian University of Athens (Greece), Technische Universität Dortmund (Germany), Tel Aviv University (Israel), Eidgenössische Technische Hochschule Zürich (Switzerland), Rijksuniversiteit Groningen (Netherlands), Freie Universität Berlin (Germany)  
See also: http://cgl.uni-jena.de/  
Abstract: The Computational Geometric Learning project aims at extending the success story of geometric algorithms with guarantees to high-dimensions. This is not a straightforward task. For many problems, no efficient algorithms exist that compute the exact solution in high dimensions. This behavior is commonly called the curse of dimensionality. We try to address the curse of dimensionality by focusing on inherent structure in the data like sparsity or low intrinsic dimension, and by resorting to fast approximation algorithms.

8.2.1.2. ERC IRON

Title: Robust Geometry Processing  
Type: IDEAS  
Instrument: ERC Starting Grant (Starting)  
Duration: January 2011 - December 2015  
Coordinator: Pierre Alliez, INRIA (France)  
See also: http://www-sop.inria.fr/geometrica/collaborations/iron/  
Abstract: The purpose of this project is to bring forth the full scientific and technological potential of Digital Geometry Processing by consolidating its most foundational aspects. Our methodology will draw from and bridge the two main communities (computer graphics and computational geometry) involved in discrete geometry to derive algorithmic and theoretical contributions that provide both robustness to noisy, unprocessed inputs, and strong guarantees on the outputs. The intended impact is to make the digital geometry pipeline as generic and ironclad as its Digital Signal Processing counterpart.

8.3. International Initiatives

8.3.1. INRIA Associate Teams

8.3.1.1. COMET

Title: Computational Methods for the analysis of high-dimensional data  
INRIA principal investigator: Steve Y. Oudot
International Partner:

Institution: Stanford University (United States)
Laboratory: Computer Science Department
Researcher: Leonidas J. Guibas

International Partner:

Institution: Ohio State University (United States)
Laboratory: Computer Science and Engineering
Researcher: Yusu Wang

Duration: 2011 - 2013
See also: http://geometrica.saclay.inria.fr/collaborations/CoMeT/index.html

CoMeT is an associate team between the Geometrica group at INRIA, the Geometric Computing group at Stanford University, and the Computational Geometry group at the Ohio State University. Its focus is on the design of computational methods for the analysis of high-dimensional data, using tools from metric geometry and algebraic topology. Our goal is to extract enough structure from the data, so we can get a higher-level informative understanding of these data and of the spaces they originate from. The main challenge is to be able to go beyond mere dimensionality reduction and topology inference, without the need for a costly explicit reconstruction. To validate our approach, we intend to set our methods against real-life data sets coming from a variety of applications, including (but not restricted to) clustering, image or shape segmentation, sensor field monitoring, shape classification and matching. The three research groups involved in this project have been active contributors in the field of Computational Topology in the recent years, and some of their members have had long-standing collaborations. We believe this associate team can help create new synergies between these groups.

8.3.1.2. DDGM

Title: Discrete Differential Geometric Modeling
INRIA principal investigator: Pierre Alliez

International Partner:

Institution: California Institute of Technology (United States)
Laboratory: Applied Geometry Lab

Duration: 2009 - 2011
See also: http://www-sop.inria.fr/geometrica/collaborations/ddgm/

Our initial goals were to collaborate on geometry processing and modeling. Our initial focus in 2009 was on the notion of quality of the computational models or discretizations: we carried out research on the generation of quality meshes through variational methods, on the generation of surface mesh parameterizations with low distortion, and on simplifications with guaranteed error bounds. The motivation was to meet the requirements imposed by simulations in computational engineering and computer animation. Amidst the completion of our project, we partially shifted our research goals when we realized that streamlining the geometry processing pipeline could be greatly facilitated if in addition to guaranteeing the output quality, we could provide robustness (i.e., resilience) to defect-laden inputs. This explains our recent focus on methods which are robust to heterogeneous data and to data hampered with a variety of defects. Sampling defects (such as non uniform, widely variable sampling, missing data) and uncertainty (noise, background noise, registration noise, outliers) are indeed increasingly present in datasets coming from cheaper and cheaper sensors. Our quest for ironclad robustness is best illustrated by two shape reconstruction methods we contributed, able to deal with noise and outliers.
8.3.1.3. OrbiCG

Title: Triangulations and meshes in new spaces
INRIA principal investigator: Monique Teillaud

International Partner:
Institution: University of Groningen (Netherlands)
Laboratory: Johann Bernoulli Institute of Mathematics and Computing Science

International Partner:
Institution: University of Groningen (Netherlands)
Laboratory: Kapteyn Astronomical Institute

Duration: 2009 - 2011
See also: http://www-sop.inria.fr/geometrica/collaborations/OrbiCG/

Due to the now established emergence of standardized software libraries, such as the Computational Geometry Algorithms Library CGAL, a result of concerted efforts by groups of researchers in Europe, and whose Geometrica is one of the leaders, the so-far mostly theoretical results developed in computational geometry are being used and extended for practical use like never before for the benefit of researchers in academia and of industry. To fulfill the promise of applicability of computational geometry and to expand the scope of initial efforts, extending the traditional focus on the Euclidean space Rd ("urbi") to encompass various spaces ("orbi") has become important and timely.

8.3.2. Visits of International Scientists

8.3.2.1. Exterior research visitors

Alla Sheffer, University of British Columbia, one week in March
David Bommes, RWTH Aachen, one week in June
Konstantin Mischaikow Rutgers University, 6 weeks in June-July
Vin de Silva Pomona College, one month in June
Mathieu Desbrun, Caltech, one week in July
Tetsuo Asano, Japan Advanced Institute of Science and Technology, one week in September
Jian Sun (Tsinghua University, Pékin), two weeks, September.
Gert Vegter, Institute of Mathematics and Computing Science, University of Groningen, NL, three weeks in October
Pratyush Pranav, Kapteyn Astronomical Institute, University of Groningen, NL, two weeks in October
Mathijs Wintraecken, Institute of Mathematics and Computing Science, University of Groningen, NL, two weeks in October
Rien van de Weijgaert, Kapteyn Astronomical Institute, University of Groningen, NL, two weeks in October

8.3.2.2. Visiting Phd students

Kan-Le Shi, Tsinghua University Beijing, 4 months.
LFANT Project-Team (section vide)
LICIT Exploratory Action

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. Lise (ANR)

The Lise\(^5\) project started in 2008 and is funded by the ANRSESUR programme. Lise is coordinated by LICIT and involves the AMAZONES and POP ARTINRIA project-teams, the Law Faculty of Versailles Saint-Quentin, the Law Faculty of Caen, VERIMAG and SUPELEC.

One of the motivations of the Lise project is the fact that, as observed by several authors, software quality and patterns of security frauds are directly related to legal liability patterns. But the precise definition of the expected functionalities of software systems is quite a challenge, not to mention the use of such definition as a basis for a liability agreement. Taking up this challenge was precisely the objective of Lise. To achieve this goal, the project has studied liability issues both from the legal and the technical points of view with the aim to put forward methods (1) to define liability in a precise and unambiguous way and (2) to establish liability in case of disagreement [5], [12], [11].

7.1.2. Fluor (ANR)

The Fluor\(^6\) project started in 2008 and is funded by the ANRSESUR programme. Fluor is coordinated by ENSTB and involves the CNRS (IODE), INRIA (LICIT), the LIUPPA (University of Pau), SWID and the University of Polynésie Française.

The context of the Fluor project is the protection of corporate documents circulating within companies. The main objectives of the project are (1) to unify information flow models and usage control models and (2) to analyse the legal issues raised by the use of these documents. Emphasis is put by LICIT on the specification of obligations within organizations [10].

7.2. European Initiatives

7.2.1. FP7 Projet

7.2.1.1. FI-WARE

Title: Future Internet Ware.
Type: COOPERATION (ICT).
Defi: PPP FI: Technology Foundation: Future Internet Core Platform.
Duration: May 2011 - April 2014.
Coordinator: Telefónica. (Spain)
Others partners: SAP (Germany), IBM (Israel, Switzerland), Thales Communications (France), Telecom Italia (Italy), France Telecom (France), Nokia Siemens Networks (Germany, Hungary, Finland), Deutsche Telekom (Germany), Technicolor (France), Ericsson (Sweden), Atos Origin (Spain), Ingenieria Informatica (Italy), Alcatel-Lucent (Italy, Germany), Siemens (Germany), Intel (Ireland), NEC (United Kingdom), Fraunhofer Institute (Germany), University of Madrid (Spain), University of Duisburg (Germany), University of Roma La Sapienza (Italy), University of Surrey (United Kingdom).

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\(^5\) http://licit.inrialpes.fr/lise/
\(^6\) http://fluor.no-ip.fr/
See also: http://www.fi-ware.eu/.

Abstract: The goal of the FI-WARE project is to advance the global competitiveness of the EU economy by introducing an innovative infrastructure for cost-effective creation and delivery of services, providing high QoS and security guarantees. FI-WARE is designed to meet the demands of key market stakeholders across many different sectors, e.g., healthcare, telecommunications, and environmental services. The project unites major European industrial actors in an unique effort never seen before. The key deliverables of FI-WARE will deliver an open architecture and implementation of a novel service infrastructure, building upon generic and reusable building blocks developed in earlier research projects. This infrastructure will support emerging Future Internet (FI) services in multiple Usage Areas, and will exhibit significant and quantifiable improvements in the productivity, reliability and cost of service development and delivery - building a true foundation for the Future Internet.

7.3. International Initiatives

7.3.1. Visits of International Scientists

Visiting scientist (one month): Gerardo Schneider from the university of Chalmers (Gothenburg, Sweden).
7. Partnerships and Cooperations

7.1. National Initiatives

- We were the leader of the ANR project Galapagos, which started on Nov. 19th 2007 and finished on Nov. 19th 2011. Other participants in this contract are the universities of Strasbourg and Poitiers, ENSIEE in Evry and the Ecole Normale Supérieure in Lyon. The objective of this contract is to study the formal description of geometric concepts and algorithms.

- We participated to the ANR SCALP, which started on January 1st, 2008. Other participants in this contract were DCS-Verimag (Grenoble), Plume-LIP (Lyon), Proval-LRI (Orsay), CPR-Cédric (Cnam, Paris). In this project we focused on the formalization of Cryptography.

- We participated to the ANR project DeCert, which started on January 2009. Other participants are CEA List (Paris), LORIA-INRIA (Nancy), Celtique (IRISA Rennes), Proval (LRI Orsay), Typical (INRIA Saclay), Systerel (Aix-en-provence). The objective of the DeCert project was to design an architecture for cooperating decision procedures. To ensure trust in the architecture, the decision procedures will either be proved correct inside a proof assistant or produce proof witnesses allowing external checkers to verify the validity of their answers.

- We participate to the ANR project TAMADI, which started in October 2010. Other participants are ARENAIRE-INRIA Rhone-Alpes and the PEQUAN team from University of Paris VI Pierre and Marie Curie. The objective of the TAMADI project is to study question of precision in floating-point arithmetic and to provide formal proofs on this topic.

7.2. European Initiatives

7.2.1. FP7 Project

7.2.1.1. FORMATH

Title: Formath
Type: COOPERATION (ICT)
Defi: FET Open
Instrument: Specific Targeted Research Project (STREP)
Duration: March 2010 - February 2013
Coordinator: University of Göteborg (Sweden)
Others partners: Radboud University Nijmegen, (the Netherlands), University of La Rioja, (Spain).
See also: http://wiki.portal.chalmers.se/cse/pmwiki.php/ForMath/ForMath

Abstract: The objective of this project is to develop libraries of formalised mathematics concerning algebra, linear algebra, real number computation, and algebraic topology. The libraries that we plan to develop in this proposal are especially chosen to have long-term applications in areas where software interacts with the physical world. The main originality of the work is to structure these libraries as a software development, relying on a basis that has already shown its power in the formal proof of the four-colour theorem, and to address topics that were mostly left untouched by previous research in formal proof or formal methods.

7.2.2. Major European Organizations with which you have followed Collaborations

Chalmers University, Programming Logic Group, (Sweden)
Type Theory and its application to formalizing of mathematics, especially algebraic concepts.

Radboud University, ICIS, Foundations group, (the Netherlands)
Type theory and its application to formalizing mathematics, especially numeric computation.

University of La Rioja, Programming and Symbolic Computation Team, (Spain)
Formal study of algebraic algorithms and application to algebraic topology.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. DIGITEO 2009-27HD CoChat: Covert Channels in Timed Systems

Participant: Serge Haddad.

Attacks with timing channels have been described and simulated for instance on TCP/IP protocols, Web communications or cryptographic operations. The scientific objective of the CoChat project is to study the conditions under which such attacks can occur in timed systems, with two main directions. a. The first step consists in defining a theoretical framework, in which timing channels can be formally described. b. A second part of the work concerns the design of detection and verification algorithms, for which decidability issues are involved. Progress in both steps will have to take into account practical examples like the case studies mentioned above, in order to validate the formal approach.

8.1.2. DIGITEO 2010 PhD Grant (LoCoReP)

Participants: Benedikt Bollig, Aiswarya Cyriac, Paul Gastin, Marc Zeitoun.

Benedikt Bollig and Paul Gastin obtained a DIGITEO PhD grant for their student Aiswarya Cyriac. The aim of the PhD will be to design linear-time temporal logics for concurrent recursive programs.

8.1.3. DIGITEO 2011 PhD Grant (TECSTES)

Participants: Stefan Haar, Hernán Ponce de Léon.

Stefan Haar and Delphine Longuet of LRI, Univ. Paris-Sud/Orsay, have obtained a DIM/LSC grant for the project TECSTES which finances the PhD thesis of their student Hernán Ponce de Léon. The subject of the project is the asynchronous testing of concurrent systems via Event Structures.

8.2. National Initiatives

8.2.1. ANR ImpRo ANR-2010-BLAN-0317

Participants: Sandie Balaguer, Thomas Chatain, Stefan Haar, Serge Haddad, Stefan Schwoon.

This project involves IRCCyN (Nantes), IRISA (Rennes), LIP6 (Paris), LSV (Cachan), LIAFA (Paris), LIF (Marseille)

It addresses the issues related to the practical implementation of formal models for the design of communicating embedded systems: such models abstract many complex features or limitations of the execution environment. The modeling of time, in particular, is usually ideal, with infinitely precise clocks, instantaneous tests or mode commutations, etc. Our objective is thus to study to what extent the practical implementation of these models preserves their good properties. We will first define a generic mathematical framework to reason about and measure implementability, and then study the possibility to integrate implementability constraints in the models. We will particularly focus on the combination of several sources of perturbation such as resource allocation, the distributed architecture of applications, etc. We will also study implementability through control and diagnostic techniques. We will finally apply the developed methods to a case study based on the AUTOSAR architecture, a standard of the automotive industry.

8.2.2. ANR CHECKBOUND ANR-06-SETI-002

Participants: Hilal Djafri, Serge Haddad.
The increasing use of computerised systems in all aspects of our lives gives an increasing importance on the need for them to function correctly. The presence of such systems in safety-critical applications, coupled with their increasing complexity, makes indispensable their verification to see if they behaves as required. Thus the model checking techniques, i.e. the automated form of formal verification, are of particular interest. Since verification techniques have become more efficient and more prevalent, the natural extension is to extend the range of models and specification formalisms to which model checking can be applied. Indeed the behaviour of many real-life processes is inherently stochastic, thus the formalism has been extended to probabilistic model checking. Therefore, different formalisms in which the underlying system has been modelled by Markovian models have been proposed.

Stochastic model checking can be performed by numerical or statistical methods. In model checking formalism, models are checked to see if the considered measures are guaranteed or not, bounding techniques become useful. We propose to apply Stochastic Comparison technique for numerical stochastic model checking. The main advantage of this approach is the possibility to derive transient and steady-state bounding distributions as well as the possibility to avoid the state space explosion problem. For the statistical model checking we propose to study the application of perfect simulation by coupling in the past. This method has been shown that to be efficient when the underlying system is monotonous for the exact steady-state distribution sampling. We consider to extend this approach for transient analysis and to model checking by means of bounding models and the stochastic monotonicity. One of difficult problems for model checking formalism, we envisage to study is when the state space is infinite. In some cases, it would be possible to consider bounding models defined in finite state space.

Indeed, formal verification using model checking and performance and dependability evaluation have a lot of things in common. We think that it would be interesting to apply the methods that we have a large experience in quantitative evaluation in the context of stochastic model checking.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. Univerself

Participants: Stefan Haar, Serge Haddad.

Title: Univerself
Type: COOPERATION (ICT)
Defi: The Network of the Future
Instrument: Integrated Project (IP)
Duration: September 2010 - August 2013
Coordinator: Alcatel Lucent (France)

Others partners:
- Universiteit Twente,
- Alcatel Lucent Ireland,
- Alcatel Lucent Deutschland,
- Valtion Teknillinen Tutkimuskeskus (Finland),
- University of Piraeus,
- France Telecom,
- Telecom Italia,
- National University of Athens,
- Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung.
MEXICO

- Interdisciplinary Institute for Broadband Technology,
- Telefonica Investigacion y Desarrollo,
- Thales Communications,
- INRIA,
- Nec Europe,
- University of Surrey,
- University College London
- IBBT (Belgium).

See also: http://www.universef-project.eu/

Abstract: UniverSelf unites 17 partners with the aim of overcoming the growing management complexity of future networking systems, and to reduce the barriers that complexity and ossification pose to further growth. Universef has been launched in October 2010 and is scheduled for four years.

8.3.2. Collaborations in European Programs, except FP7

8.3.2.1. DISC: Grant Agreement 224498

Participants: Stefan Haar, Serge Haddad.

Serge Haddad and Stefan Haar are participating, as associate members of INRIA Rennes, in the Project on Distributed Supervisory Control of Large Plants - DISC. The European Commission supports the project financially by the EU.ICT program, Challenge ICT-2007.3.3 (Information and Communication Technologies (ICT)). 1 September 2008 - 1 September 2011. Project partners:

- University of Cagliari (coordinator),
- CWI - Amsterdam, Ghent University,
- Technical University of Berlin,
- University of Zaragoza,
- INRIA,
- Akhela s.r.l. Italy,
- Czech Academy of Sciences,
- Ministry of the Flemish Government,
- CyBio AG.

Serge Haddad and Stefan Haar are among the INRIA participants of the IP Universef on autonomous Management in telecommunications, along with members of the Distribcom group at INRIA Rennes and the MADYNES group at INRIA Nancy. The project consortium is:

8.3.2.2. Hycon2

Participants: Stefan Haar, Serge Haddad.

Title: Hycon2 (Highly-complex and networked control systems)
Type: COOPERATION (ICT)
Defi: Engineering of Networked Monitoring and Control Systems
Instrument: Network of Excellence (NoE)
Duration: September 2010 - August 2014
Coordinator: CNRS (France)
Others partners:
8.3.3. Major European Organizations with which we cooperate

- TU München, Lehrstuhl Esparza (Germany) organisme 1, labo 1 (pays 1)
- University of Padova, Department of Pure and Applied mathematics (Italy)
- DISCO team, Università degli Studi di Milano (Italy)

8.4. International Initiatives

8.4.1. Visits of International Scientists
• Madhavan Mukund of CMI Chennai, India, visited (within the ARCUS project) from May 1 to May 2011.
• K. Narayan Kumar of CMI Chennai, India, visited (within the ARCUS project) from May 2 to June 5 and from Nov 7 to November 20.
• From February 23 to 25, the team received the visit of Lucia Pomello, Luca Bernardinello (both professors of the University of Milan, Italy) and Carlo Ferigato researcher at JRC Ispra, Italy.

8.4.1.1. Internship

Roshan Kumar (IIT Delhi, India) cancelled his summer internship due to illness

Subject: Petri net unfolding methods for verifying weak properties
Institution: IIT Delhi (India)

8.4.2. Visit to other laboratories

• Stefan Schwoon visited the LABRI on February 16 to work with Jerome Leroux and to give a talk in the MVTSI seminar. From Nov 17 to 21, he visited Javier Esparza’s group at TU München and gave a talk in the PUMA seminar.
• Within the DISC project, Serge Haddad and Stefan Haar participated in the project meeting at CWI Amsterdam, March 14–16, and the summer school in Cagliari, June 6-10.
• Stefan HAAR visited the DISCO team of Lucia Pomello and Luca Bernardinello at University of Milan from June 8 to June 10.
• In October 2011, Benedikt Bollig joined Dietrich Kuske’s group at the Technische Universität Ilmenau, Germany, for two weeks.
• Serge Haddad gave talks at the DISC summer school in Cagliari (June 6-10) and an invited talk at the summer school of the University of Western Brittany (August 29 to September 1).

8.4.3. Participation In International Programs

8.4.3.1. ARCUS Inde

Most members of the team have participated in the sub-project 4, Formal approaches for computer systems, of the Île de France/INDE project of the ARCUS Program (Region Île de France and French Ministry of foreign affairs), initially funded for 3 years (2008-2010) and extended until September 2011.

To pursue the very active and fruitful collaboration with our Indian partners, we have proposed the creation of an INTERNATIONAL ASSOCIATED LABORATORY (LIA). The LIA is called INFORMEL which stands for INdo-French FORmal MEthods Lab. The scientific coordinators are Paul Gastin (LSV, ENS Cachan) and Madhavan Mukund (CMI, Chennai). The french partners are mainly from LSV (ENS Cachan) and LaBRI (Bordeaux). The indian partners are from the Chennai Mathematical Institute (CMI), the Institute of Mathematical Sciences (IMSc) and the Indian Institute of Science (IISc) of Bangalore. The LIA proposal has been positively evaluated by the CoNRS and should be created on January 1st 2012.
MOSCOVA Project-Team (section vide)
7. Partnerships and Cooperations

7.1. National Initiatives

We participate in the “Logic and Complexity” part of the GDR–IM (CNRS Research Group on Mathematical Computer Science), in the projects “Logic, Algebra and Computation” (mixing algebraic and logical systems) and “Geometry of Computation” (using geometrical and topological methods in computer science).

We participate and co-animate the “Transformation” group of the GDR–GPL (CNRS Research Group on Software Engineering).

7.1.1. ANR Complice (2009-2012)

Participant: Yves Guiraud.

The ANR project “Complexité implicite, concurrence et extraction” (Complice), headed by Patrick Baillot (CNRS, LIP Lyon), federates researchers from Lyon (LIP), Nancy (LORIA) and Villetaneuse (LCR). The coordinator for the LORIA site is Guillaume Bonfante (Carte).

7.1.2. ARC ACCESS (2010-2011)

Participant: Horatiu Cirstea.

This project is concerned with the security and access control for Web data exchange, in the context of Web applications and Web services. We aim at defining automatic verification methods for checking properties of access control policies (ACP) for XML, like consistency or secrecy. A more detailed presentation is available at http://acxml.gforge.inria.fr/.

7.1.3. FRAE QUARTEFT (2009-2012)

Participants: Jean-Christophe Bach, Horatiu Cirstea, Pierre-Etienne Moreau.

“QUARTEFT: QUAlifiable Real TimE Fiacre Transformations” is a research project founder by the FRAE (Fondation de Recherche pour l’Aéronautique et l’Espace). A first goal is to develop an extension of the Fiacre intermediate language to support real-time constructs. A second goal is to develop new model transformation techniques to translate this extended language, Fiacre-RT, into core Fiacre. A main difficulty consists in proposing transformation techniques that could be verified in a formal way. A more detailed presentation is available at http://quarteft.loria.fr/dokuwiki/.

7.2. International Initiatives

7.2.1. Visits of International Scientists

Cooperation with Prof. Mark van den Brand from Technical University of Eindhoven.
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. INRIA Action d’Envergure Synchronics

Participants: Albert Cohen, Marc Pouzet [contact], Louis Mandel.

This project is funded by INRIA for 4 years and started in Jan. 2008. The coordinators are A. Girault (INRIA Rhône Alpes) and M. Pouzet. http://synchronics.inria.fr/

The goal of the project is to propose new languages for the development of embedded systems allowing from a unique source to both simulate the system with its environment and generate code. It capitalizes on recent extensions of data-flow synchronous languages (Lucid Synchrone, ReactiveML), a relaxed form of synchrony, and means to mix discrete and continuous systems inside the synchronous model of time.

The project focuses on language extensions to increase modularity, dedicated type systems to ensure safety properties, efficient compilation and the mix of discrete and continuous time.

Partners: INRIA Rhône Alpes (Gwenaël Delaval, Alain Girault, Bertrand Jeannet), IRISA (Benoit Caillaud), VERIMAG (Erwan Jahier, Pascal Raymond), INRIA Rocquencourt (Albert Cohen, Marc Pouzet, Louis Mandel)

8.1.2. PARTOUT

Participants: Mehdi Dogguy, Louis Mandel [contact], Cédric Pasteur, Marc Pouzet.

This project is funded by ANR (program DEFIS). http://www-sop.inria.fr/mimosa/PARTOUT

It started on January 2009 for 4 years; the coordinator is Frédéric Boussinot from INRIA Indes.

Partners: INRIA Indes, CNAM, LRI.

The goal of the project PARTOUT is, from a programming language point of view, to study the impact on programming of the globalization of parallelism which now covers all the spectrum of informatics, ranging from multicore architectures and distributed systems, up to applications deployed on the Web.

8.1.3. Mediacom Project

Participants: Albert Cohen [contact], Ramakrishna Upadrasta.

Partners: INRIA CompSys, ALF, Arenaire.

Mediacom is one of the projects of the Nano2012 collaboration framework between STMicroelectronics and INRIA, 09/2009–12/2012. Mediacom is a collaboration between the compilation group of STMicroelectronics HED, led by Christian Bertin, and the INRIA CompSys, ARENAIRE, ALF and PARKAS (formerly ALCHEMY) groups. We are working on portable concurrent intermediate languages, inspired by data-flow synchronous languages and polyhedral compilation, and on just-in-time parallelization algorithms.

8.2. European Initiatives

8.2.1. HiPEAC network of excellence

HiPEAC is a network of excellence on High-Performance Embedded Architectures and Compilers. It was first established as an FP6 network in 2004, and renewed as an FP7 4 years later. INRIA is one of the partners of the network. Albert Cohen leads the Compiler Platform cluster (9 research clusters in total). 02/2008–01/2012.
8.2.2. TERAFLUX integrated project

The TERAFLUX project is funded under the FP7 FET pro-active program on teradevice computing, 01/2010-12/2013. Albert Cohen is responsible for WP4. Our work addresses data-flow synchronous parallel programming, polyhedral compilation for data-flow programs, and compiler support for data-driven multi-threaded architectures with hundreds of computing cores. We contribute compilation algorithms and experimental language designs, with prototypes based on LUCID SYNCHROME and direct contributions to GCC through the design of data-flow synchronous extensions of OpenMP. One of our goals is to transfer results of the project to production tools, including GCC and simulation platforms for many-core processors. A standardization effort (supported by INRIA’s D2T) aims for the adoption of the language extensions by the OpenMP Architecture Review Board.

8.2.3. PHARAON specific targeted research project

The PHARAON project is funded on the embedded systems strategic objective, 09/2011–08/2014. Albert Cohen is responsible for WP5. Our work addresses data-flow synchronous programming for multiprocessor systems-on-chip, with an emphasis on an embedded development methodology and tools to optimize energy consumption and facilitate the correct-by-construction refinement of a functional specification. The Heptagon and Streaming OpenMP platforms of the team are used in the project. PHARAON is led by Thales Communications and Security.

8.2.4. CARP specific targeted research project

The CARP project is funded on the computing systems strategic objective, 12/2011–11/2014. Our work addresses polyhedral automatic parallelization for vector accelerators, with an emphasis on extending the scope of polyhedral compilation and integrating vectorization and specialization techniques. isl is an important component of this work, along with a new source-to-source compilation framework being developed in the project. CARP is led by Imperial College, and our team collaborates closely with ARM Cambridge in the specification of a portable parallel intermediate language to facilitate automatic parallelization and vectorization.

8.2.5. Collaborations in European Programs, except FP7

8.2.5.1. Euro-TM COST action

This new action started in April 2011. It aims at consolidating European research on transactional memory, by coordinating the research groups working on the development of complementary, interdisciplinary aspects of Transactional Memories, including theoretical foundations, algorithms, hardware and operating system support, language integration and development tools, and applications. Our participation is focused on the interaction between data-flow and transactional memory models.

8.3. International Initiatives

8.3.1. Visits of International Scientists

8.3.1.1. International guests of the PARKAS seminars

- November 2011: Alex Nicolau, UCI. Variability, Accuracy, and Performance evaluation.
- September 2011: Daisuke Ishii, JSPS, National Institute of Informatics (Tokyo) and ProVal team, INRIA Saclay. An Execution Algorithm for a Hybrid Modeling Language HydLa.
- August 2011: Peter Gammie, the Australian National University and National ICT Australia. Verified Synthesis of Knowledge-Based Programs in Finite Synchronous Environments.
- June 2011: Jan Vitek, Purdue University. Virtualizing Real-time Embedded Systems with Java.

8.3.1.2. Other visits

• John Cavazos, University of Delaware, visited us in January and July 2011. We have been collaborating on statistical methods in polyhedral compilation since John’s postdoc at the University of Edinburgh. A joint paper was published at CGO 2011. Albert Cohen is on the PhD thesis committee of his student, Eunjung Park.

• P. Sadayappan, Ohio State University, visited us in December 2011. We collaborate for a long time on polyhedral compilation methods and tools. A joint paper was published at POPL 2011. P. Sadayappan has been the Master thesis advisor of Tobias Grosser and he is participating to the direction of his PhD thesis, and he hosts a former student, Louis-Noël Pouchet for more than 1 year as a postdoc.

• John Plaice, University of New South Wales, visited us in December 2011. He is a long-time synchronous programming and functional programming expert. His Translucid language experiment could be the basis for a collaboration on efficient compilation of array-based computations and synchronous language expressiveness.

8.3.1.3. Supervision of post-docs, theses and Internships

• Marc Pouzet supervised the 12-month post-doc of Timothy Bourke, from the University of New South Wales, from September 2010 to October 2011, and funded by the large scale initiative SYNCHRONICS of INRIA. Timothy worked on the semantics and implementation of hybrid modelers.

• Albert Cohen co-advised the PhD thesis of Sean Halle, from the University of California Santa Cruz, defended in June 2011. Sean Halle worked on parallel programming models and analytical performance models.
7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. CPP: ANR on Confidence, Proofs, and Probabilities

Participants: Ivan Gazeau, Dale Miller.

The ANR Blanc titled “CPP: Confidence, Proofs, and Probabilities” has started 1 October 2009. This grant brings together the following institutions and individuals: LSV (Jean Goubault-Larrecq), CEA LIST (Eric Goubault, Olivier Bouissou, and Sylvie Putot), INRIA Saclay (Catuscia Palamidessi, Dale Miller, and Stephane Gaubert), Supelec L2S (Michel Kieffer and Eric Walter), and Supelec SSE (Gilles Fleury and Daniel Poulton). This project proposes to study the joint use of probabilistic and formal (deterministic) semantics and analysis methods, in a way to improve the applicability and precision of static analysis methods on numerical programs. The specific long-term focus is on control programs, e.g., PID (proportional-integral-derivative) controllers or possibly more sophisticated controllers, which are heavy users of floating-point arithmetic and present challenges of their own. To this end, we shall benefit from case studies and counsel from Hispano-Suiza and Dassault Aviation, who will participate in this project, but preferred to remain formally non-members, for administrative reasons.

7.1.2. Panda: ANR on Parallelism and Distribution Analysis

Participant: Dale Miller.

The ANR Blanc titled “Panda: Parallelism and Distribution Analysis” has started 1 October 2009. This project brings together researchers from INRIA Saclay (Comète and Parsifal), CEA LIST, MeASI as well labs in Paris (LIPN, PPS, LSV, LIP, LAMA), and on the Mediterranean (LIF, IML, Airbus). Scientifically, this proposal deals with the validation of concurrent and distributed programs, which is difficult because the number of its accessible states is too large to be enumerated, and even the number of control points, on which any abstract collecting semantics is based, explodes. This is due to the great number of distinct scheduling of actions in legal executions. This adds up to the important size of the codes, which, because they are less critical, are more often bigger. The objective of this project is to develop theories and tools for tackling this combinatorial explosion, in order to validate concurrent and distributed programs by static analysis, in an efficient manner. Our primary interest lies in multithreaded shared memory systems. But we want to consider a number of other paradigms of computations, encompassing most of the classical ones (message-passing for instance as in POSIX or VXWORKS) as well as more recent ones.

7.1.3. PSI: ANR on Proof Search in Interaction with Domain-specific methods

Participants: Stéphane Lengrand, Mahfuza Farooque.

The ANR Jeune Chercheuse / Jeune chercheur titled “PSI: Proof Search in Interaction with Domain-specific methods” has started 1 September 2009. This project investigates how proof-search can be performed in a framework where reasoning is subject to highly specific inference rules or axioms. This encompasses reasoning modulo a theory for which we may have a decision procedure (linear arithmetic, etc), or reasoning in a particular type theory (e.g. in a Pure Type system). The field of automated reasoning offers a variety of techniques (SAT-modulo-Theory, etc) which we like to see in terms of proof search. The project represent 192 000 euros of funding over four years, and is in collaboration with Assia Mahboubi at the TypiCal team.
7.2. International Initiatives

7.2.1. STRUCTURAL: ANR blanc International

Participants: Kaustuv Chaudhuri, Nicolas Guenot, Willem Heijltjes, Clément Houtmann, Dale Miller, Lutz Straßburger.

- Title: Structural and computational proof theory
- Duration: 01/01/2011 – 31/12/2013
- Partners:
  - University Paris VII, PPS (PI: Michel Parigot)
  - INRIA Saclay–IdF, EPI Parsifal (PI: Lutz Straßburger)
  - University of Innsbruck, Computational Logic Group (PI: Georg Moser)
  - Vienna University of Technology, Theory and Logic Group (PI: Matthias Baaz)
- Total funding by the ANR: 242 390,00 EUR (including 12 000 EUR pôle de compétitivité: SYST-TEMTIC Paris région)

This project is a consortium of four partners, two French and two Austrian, all being internationally recognized for their work on structural proof theory, but each coming from a different tradition. One of the objective of the project is build a bridge between these traditions and develop new proof-theoretic tools and techniques of structural proof theory having a strong potential of applications in computer science, in particular at the level of the models of computation and the extraction of programs and effective bounds from proofs.

On one side, there is the tradition coming from mathematics, which is mainly concerned with first-order logic, and studies, e.g., Herbrand’s theorem, Hilbert’s epsilon-calculus, and Gödel’s Dialectica interpretation. On the other side, there is the tradition coming from computer science, which is mainly concerned with propositional systems, and studies, e.g., Curry-Howard isomorphism, algebraic semantics, linear logic, proof nets, and deep inference. A common ground of both traditions is the paramount role played by analytic proofs and the notion of cut elimination. We will study the inter-connections of these different traditions, in particular we focus on different aspects and developments in deep inference, the Curry-Howard correspondence, term-rewriting, and Hilbert’s epsilon calculus. As a byproduct this project will yield a mutual exchange between the two communities starting from this common ground, and investigate, for example, the relationship between Herbrand expansions and the computational interpretations of proofs, or the impact of the epsilon calculus on proof complexity.

Besides the old, but not fully exploited, tools of proof theory, like the epsilon-calculus or Dialectica interpretation, the main tool for our research will be deep inference. Deep inference means that inference rules are allowed to modify formulas deep inside an arbitrary context. This change in the application of inference rules has drastic effects on the most basic proof theoretical properties of the systems, like cut elimination. Thus, much of the early research on deep inference went into reestablishing these fundamental results of logical systems. Now, deep inference is a mature paradigm, and enough theoretical tools are available to think to applications. Deep inference provides new properties, not available in shallow deduction systems, namely full symmetry and atomicity, which open new possibilities at the computing level that we intend to investigate in this project. We intend to investigate the precise relation between deep inference and term rewriting, and hope to develop a general theory of analytic calculi in deep inference. In this way, this project is a natural continuation of the ANR project INFER which ended in May 2010.

7.2.2. Eternal: INRIA ARC

Participants: Kaustuv Chaudhuri, Dale Miller, Lutz Straßburger.

Title: Interactive Resource Analysis
webpage: http://eternal.cs.unibo.it/
INRIA principal investigator: Dale Miller

INRIA Partner:
   Institution: INRIA
   Team: FOCUS
   Researcher: Ugo Dal Lago

INRIA Partner:
   Institution: INRIA
   Team: pi.r2
   Researcher: Pierre-Louis Curien

Duration: 2011 - 2013

This project aims at putting together ideas from Implicit Computational Complexity and Interactive Theorem Proving, in order to develop new methodologies for handling quantitative properties related to program resource consumption, like execution time and space. The task of verifying and certifying quantitative properties is undecidable as soon as the considered programming language gets close to a general purpose language. So, full-automatic techniques in general cannot help in classifying programs in a precise way with respect to the amount of resources used and moreover in several cases the programmer will not gain any relevant information on his programs. In particular, this is the case for all the techniques based on the study of structural constraints on the shape of programs, like many of those actually proposed in the field of implicit computational complexity. To overcome these limitations, we aim at combining the ideas developed in the linear logic approach to implicit computational complexity with the ones of interactive theorem proving, getting rid of the intrinsic limitations of the automatic techniques. In the obtained framework, undecidability will be handled through the system’s user, who is asked not only to write the code, but also to drive the semi-automatic system in finding a proof for the quantitative properties of interest. In order to reduce the user effort and allow him to focus only on the critical points of the analysis, our framework will integrate implicit computational complexity techniques as automatic decision procedures for particular scenarios. Moreover, in order to be widely applicable, the modularity of the framework will permit to deal with programs written in different languages and to consider different computational resources. The kind of study proposed by this project has been almost neglected so far. Here, we aim at providing such a framework for both theoretic investigations and for testing in practice the effectiveness of the approach.

7.2.3. INRIA Associate Teams

7.2.3.1. RAPT

Participants: Beniamino Accattoli, Kaustuv Chaudhuri, Quentin Heath, Clément Houtmann, Dale Miller.

Title: Computational logic systems

INRIA principal investigator: Kaustuv Chaudhuri

International Partner:
   Institution: McGill University (Canada)
   Laboratory: School of Computer Science
   Researcher: Brigitte Pientka

International Partner:
   Institution: Carnegie Mellon University (United States)
Laboratory: Department of Computer Science
Researcher: Frank Pfenning

Duration: 2011 - 2013
See also: http://www.lix.polytechnique.fr/~kaustuv/rapt/

Many aspects of computation systems, ranging from operational semantics, interaction, and various forms of static analysis, are commonly specified using inference rules, which themselves are formalized as theories in a logical framework. While such a use of logic can yield sophisticated, compact, and elegant specifications, formal reasoning about these logic specifications presents a number of difficulties. The RAPT project will address the problem of reasoning about logic specifications by bringing together three different research teams, combining their backgrounds in type theory, proof theory, and the building of computational logic systems. We plan to develop new methods for specifying computation that allow for a range of specification logics (eg. intuitionistic, linear, ordered) as well as new means to reason inductively and co-inductively with such specifications. New implementations of reasoning systems are planned that use interactive techniques for deep meta-theoretic reasoning and fully automated procedures for a range of useful theorems.

7.2.4. Visits of International Scientists

7.2.4.1. Invited Researchers

- Alberto Momigliano, Associate Professor, University of Milan
  24 - 28 January and 30 - 31 August.
- Vivek Nigam, Research Scientist, LMU, Munich, Germany.
  26 April - 6 May.
- Chuck Liang, Professor, Hofstra University, NY, USA.
  2 June - 1 July
- Gopalan Nadathur, Professor, University of Minnesota, MN, USA.
  6 - 10 June and 3 - 28 October.
- Elaine Pimentel, Associate Professor, Universidade Federal de Minas Gerais.
  13 - 24 June.
- Brigitte Pientka, Associate Professor, McGill University, Montreal, Canada.
  16 - 20 May.
- Alwen Tiu, Research Scientist, Australian National University.
  22 - 26 August.
- Anupam Das, PhD Student, University of Bath, UK.
  21 - 25 November 2011

7.2.4.2. Internships

- Andrew Cave, PhD student at McGill Univ., Montreal, Canada.
  Internship during May – July 2011
- Salil Joshi, PhD student at Carnegie Mellon Univ., USA.
  Internship during June – August 2011
- Chris Martens, PhD student at Carnegie Mellon Univ., USA.
  Internship during June – August 2011

7.2.5. Participation In International Programs

The team has travel funds within the following international programs.

- PHC Germaine de Staël 2011: funding travel between Bern, Switzerland and INRIA.
- 63.123 - 63ème CPCFQ: Commission permanente de coopération franco-québécoise: funding exchanges between the McGill and INRIA.

- INRIA-FAPEMIG: funding between INRIA and the Brazilian funding agency FAPEMIG located in the state of Minas Gerais.
PI.R2 Project-Team

8. Partnerships and Cooperations

8.1. International Initiatives

8.1.1. INRIA Associate Teams

8.1.1.1. SEMACODE

Title: Proof theory and functional programming languages
INRIA principal investigator: Alexis SAURIN
International Partner:
Institution: University of Oregon (United States)
Laboratory: Computer and Information Science Department
Researcher: Zena ARIOLA
International Partner:
Institution: University of Novi Sad
Laboratory: Faculty of Engineering
Researcher: Silvia GHILEZAN
Duration: 2011 - 2013
See also: http://www.pps.jussieu.fr/~saurin/EA-SEMACODE

Cross-fertilization between logic and programming languages theory is at the root of many striking developments in programming concepts as well as tools for formal analysis of programs. Our associated team project aims at gathering senior and young researchers from both sites in order to put a joint research effort on the following research themes:
- formalizing particular evaluation strategies of functional languages based logical techniques coming from sequent calculi.
- More specifically, we shall be interested in incorporating control operator directly in call-by-need and in developing a uniform framework for call-by-value and call-by-name calculi with delimited control investigating (delimited) control operators, in particular to unveil the logical interpretation of delimited control (that is its logical counter-part with respect to Curry-Howard correspondence), and developing:
- connections between delimited control and stream calculi;
- developing the logical content of realistic abstract machines and associated formal analysis tools for realistic abstract machines building on Curien-Herbelin lambda-bar calculi. The project will gather PiR2 expertise in proof theory and in the logical foundations of functional programming languages, the expertise of the oregonian group on call-by-need evaluation and delimited control as well as respective crucial inputs of Gaboardi and Ghilezan on stream calculi, delimited control, semantics and type theory. The project will in particular allow to have the INRIA and American students and post-docs involved in the project (7 out of 13 people involved) to travel between both sites and to organize joint workshops (one such workshop is planned in June 2011).

8.1.2. Visits of International Scientists

Olivier Danvy (University of Aarhus) visited πr² and PPS for one month and gave a talk on call-by-need abstract machines.

Beta Ziliani (MPI, Sarbrucken) visited πr² and PPS for a week in november and gave a talk on ad-hoc proof automation.
Danko Ilik visited $\pi r^2$ and PPS for one week and gave a talk on normalization by evaluation for delimited control.

Silvia Ghilezan (University of Novi Sad) visited $\pi r^2$ and PPS for one week and worked with Alexis Saurin and Hugo Herbelin on the classification of several calculi of delimited control.

Zerna Ariola (University of Oregon) visited $\pi r^2$ for one week and worked with Alexis Saurin and Hugo Herbelin on the definition of abstract amchines for classical call-by-need.

Keiko Nakata (University of Tallin) visited $\pi r^2$ and worked with Hugo Herbelin on recursive definitions and control operators in call-by-need $\lambda$-calculus.

Gyesik Lee visited $\pi r^2$ for one week and worked with Hugo Herbelin on the formal representation of binders in Coq and on representing primitive recursive arithmetic in Coq.

8.1.2.1. Internship

Paul Downen and Luke Maurer (University of Oregon) spent two months in the team during the summer, working with Alexis Saurin and Hugo Herbelin. Paul Downen studied calculi for multi-prompt, the derivation of abstract machines as well as infinitary $\lambda$-calculi. Luke Maurer studied Coq and did some formalization in Coq and studied Zeilberger’s polarized approach to delimited control as well as connections with $\Lambda\mu$-calculus.

8.1.3. Visits abroad of members of the team

Matthieu Sozeau visited Ana Bove in Gothenburg for a week in January and gave a talk on Equations and dependent pattern-matching. They worked on a joint paper on tools and methods for recursion in type theory.

Matthieu Sozeau visited Alexandar Nanvesky at IMDEA Madrid from 19th to 23rd October and gave a talk on Type Classes and unification. They worked on the unification algorithm of Coq.

Guillaume Munch-Maccagnoni visited the Programming, Logic, and Semantics Group at the University of Cambridge from March to June. He is grateful to the Fondation Sciences Mathematiques de Paris which provided the funding.

Pierre-Louis Curien visited the University of Tsinghua in Beijing for three months, from March to May (funded by the Professor Group Chair of the Software School of this university). He was hosted by Gu Ming and Jean-Pierre- Jouannaud.
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR AutoChem: Chemical Programming

Participants: Pascal Fradet [contact person], Marnes Hoff.

The AUTOChem project aims at investigating and exploring the use of chemical languages (see Section 6.7.3) to program complex computing infrastructures such as grids and real-time deeply-embedded systems. The consortium includes INRIA Rennes – Bretagne Atlantique (PARIS team, Rennes), INRIA Grenoble – Rhône-Alpes (POP ART team, Montbonnot), IBISC (CNRS/Université d’Evry) and CEA List (Saclay). The project started at the end of 2007 and ended in November 2011.

8.1.2. ANR Asopt: Analyse Statique et OPTimisation

Participants: Bertrand Jeannet [contact person, coordinator], Lies Lakhdar-Chaouch, Pascal Sotin, Peter Schrammel.

The ASOPT (Analyse Statique et OPTimisation) project [end of 2008-2011] brings together static analysis (INRIA-POP ART, VERIMAG, CEA LMeASI), optimisation, and control/game theory experts (CEA LMeASI, INRIA-MAXPLUS) around some program verification problems. POP ART is the project coordinator.

Many abstract interpretations attempt to find “good” geometric shapes verifying certain constraints; this not only applies to purely numerical abstractions (for numerical program variables), but also to abstractions of data structures (arrays and more complex shapes). This problem can often be addressed by optimisation techniques, opening the possibility of exploiting advanced techniques from mathematical programming.

The purpose of ASOPT is to develop new abstract domains and new resolution techniques for embedded control programs, and in the longer run, for numerical simulation programs.

8.1.3. ANR Vedecy: Verification and Design of Cyber-physical Systems

Participants: Gregor Goessler [contact person], Bertrand Jeannet, Sebti Mouelhi.

The VEDECY project brings together hybrid systems and formal methods experts. Three partners are involved: Laboratoire Jean Kuntzmann (LJK), INRIA POP ART, and VERIMAG.

VEDECY aims at pursuing fundamental research towards the development of algorithmic approaches to the verification and design of cyber-physical systems. Cyber-physical systems result from the integration of computations with physical processes: embedded computers control physical processes which in return affect computations through feedback loops. They are ubiquitous in current technology and their impact on lives of citizens is meant to grow in the future (autonomous vehicles, robotic surgery, energy efficient buildings, ...).

Cyber-physical systems applications are often safety critical and therefore reliability is a major requirement. To provide assurance of reliability, model based approaches and formal methods are appealing. Models of cyber-physical systems are heterogeneous by nature: discrete dynamic systems for computations and continuous differential equations for physical processes. The theory of hybrid systems offers a sound modeling framework for cyber-physical systems. The purpose of VEDECY is to develop hybrid systems techniques for the verification and the design of cyber-physical systems.

8.1.4. INRIA Large Scale Action Synchronics: Language Platform for Embedded System Design

Participants: Gwenaël Delaval, Alain Girault [contact person, co-coordinator], Bertrand Jeannet, Xavier Nicollin, Peter Schrammel.

**SYNCHRONICS** capitalizes on recent extensions of data-flow synchronous languages, as well as relaxed forms of synchronous composition or compilation techniques for various platform, to address two main challenges with a language-centered approach: (i) the co-simulation of mixed discrete-continuous specifications, and more generally the co-simulation of programs and properties (either discrete or continuous); (ii) the ability, inside the programming model, to account for the architecture constraints (execution time, memory footprint, energy, power, reliability, etc.).

### 8.1.5. Collaborations inside INRIA

- Vertecs at INRIA Rennes – Bretagne Atlantique is working with us on applications of discrete controller synthesis, and in particular on the tool **SIGALI**.
- P. Fradet cooperates with R. Douence (ASCOLA, École des Mines de Nantes) on aspect-oriented programming.
- G. Goessler cooperates with D. Le Métayer (LICT, INRIA Grenoble – Rhône-Alpes) on logical causality and with G. Salaün (VASY, INRIA Grenoble – Rhône-Alpes) on realizability of choreographies with asynchronous communication.
- B. Jeannet cooperates with A. Miné and X. Rival (ABSTRACTION, INRIA Paris – Rocquencourt) and X. Allamigeon (MAXPLUS, INRIA Saclay – Île-de-France) on static analysis and abstract interpretation.
- G. Delaval cooperates with H. Marchand (VERTECS, INRIA Rennes – Bretagne Atlantique) and É. Rutten (SARDES, INRIA Grenoble – Rhône-Alpes) on modular controller synthesis and its applications.
- G. Delaval, A. Girault and B. Jeannet collaborate with the PARKAS team of ENS Ulm (INRIA Paris – Rocquencourt) on the distribution of higher-order synchronous data-flow programs and on static analysis of hybrid programs.

### 8.1.6. Cooperations with other laboratories

- P. Fradet cooperates with J.-L. Giavitto (CNRS/Ircam) on refinement of chemical programs.
- A. Girault collaborates with P. Roop, Z. Salcic, and S. Andalam (University of Auckland, New Zealand) and A. Malik (IBM Watson, USA) in the context of the AFMES associated team, with H. Kalla (University of Batna, Algeria) and I. Assayad (University of Casablanca, Morocco) on multicriteria scheduling.
- G. Goessler collaborates with A. Girard (LJK, Grenoble) on multi-scale controller synthesis, with J. Sifakis (EPFL) on distribution under real-time constraints, with J.-B. Raclet (IRIT, Toulouse) on modal contracts, with I. Lee and O. Sokolsky (U. of Pennsylvania) on causality analysis for medical devices, and with M. Bozga (VERIMAG) and B. Bonakdarpour (U. of Waterloo, Canada) on fault tolerance in component-based systems.
- A. Girault and G. Goessler collaborate with P. Roop (University of Auckland, New Zealand) on incremental converter synthesis.
• B. Jeannet collaborates with N. Halbwachs and M. Péron (VERIMAG), E. Goubault and S. Putot (CEA Saclay) on static analysis and abstract interpretation.
• G. Delaval and A. Girault collaborate with X. Nicollin (VERIMAG) on the automatic distribution of synchronous programs.

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7

Program: ARTEMISIA.
Project acronym: CESAR32.
Project title: Cost-efficient methods and processes for safety relevant embedded systems.
Duration: January 2009 – April 2012.
Partners: There are 59 partners from academia and industry (both SMEs and large companies).
Abstract: We are particularly involved in the following sub-programs:
  SP1: Task Force Safety 1.5.1 (State of the art survey on safety and diagnosability for cost-efficient safety critical embebedded systems) and 1.5.2 (Identification of requirements for comon cross domain core safety and diagnosability techniques and methods).
  SP2: Requirements Engineering, along with two other INRIA teams (S4 and TRISKELL, from INRIA Rennes). We shall work on contracts based design for traceability.

8.3. International Initiatives

8.3.1. INRIA Associate Teams

8.3.1.1. AFMES

Title: Advanced Formal Methods for Embedded Systems.
INRIA principal investigator: Alain Girault.
International Partner:
  Institution: University of Auckland (New Zealand).
  Laboratory: Department of Electrical and Computer Engineering.
  Principal investigator: Zoran Salcic.
Duration: January 2010 – December 2012.
See also: http://pop-art.inrialpes.fr/~girault/Projets/Afmes/
Embedded systems are characterized by several constraints, such as determinism and bounded reaction time. Accordingly, design methods for embedded systems should, when possible, guarantee these properties by construction. This allows the shifting of the burden of checking these constraints from the programmer to the design method and the associated compilers and code generation tools. In order to achieve this, our goal is to improve the existing design methods in several key directions: (1) Incremental converter synthesis. (2) Programming language for adaptive computing (SystemJ and beyond). (3) Time predictable programming language and execution architectures. Together, these advanced methods will provide a higher level of safety in the design of embedded systems.

8.3.2. Visits of International Scientists

• Hamoudi Kalla, assistant professor at University of Batna, Algeria, September 2011.
• Ismail Assayad, assistant professor at University of Casablanca, Morocco, September 2011.

8.3.2.1. Internship

• Emmanouil Komninos, 02-07/2011, co-advised by Pascal Fradet and Alain Girault, Power consumption optimization of data-flow applications on many-core systems, MSc at KTH, Sweden.

32 http://www.cesarproject.eu
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Hisseo

Participants: Sylvie Boldo [contact], Claude Marché, Guillaume Melquiond, Thi-Minh-Tuyen Nguyen.

Hisseo is a 3 years Digiteo project that started in September 2008. http://hisseo.saclay.inria.fr

The Hisseo project focuses on the problems related to the treatment of floating-point computations in the compilation process, especially in the case of the compilation of critical C code.

Partners: CEA List (Saclay), INRIA Paris-Rocquencourt (Team Gallium).

8.1.2. Coquelicot

Participants: Sylvie Boldo [contact], Catherine Lelay, Guillaume Melquiond.

Coquelicot is a 3 years Digiteo project that started in September 2011. http://coquelicot.saclay.inria.fr . S. Boldo is the principal investigator of this project.

The Coquelicot project aims at creating a modern formalization of the real numbers in Coq, with a focus on practicality. This is sorely needed to ease the verification of numerical applications, especially those involving advanced mathematics.

Partners: LIX (Palaiseau), University Paris 13

8.1.3. Pactole

Participants: Évelyne Contejean, Jean-Christophe Filliâtre, Xavier Urbain [contact].

Pactole is a 3 year Digiteo project which started in October 2009.

The Pactole project focuses on automation and formal verification for ubiquitous, large scale environments. Tasks include proof automation techniques for distributed systems, verification conditions for fault tolerant distributed systems, specification and design of fundamental services for mobile sensor networks. The principal investigator of Pactole is Xavier Urbain.

Partners: CÉDRIC (CNAM/ENSIIE), LIP6 (UPMC).

8.2. National initiatives

8.2.1. U3CAT

Participants: Jean-Christophe Filliâtre, Claude Marché [contact], Guillaume Melquiond, Kalyan Krishnamani, Asma Tafat, Paolo Herm.  

U3CAT (Unification of Critical C Code Analysis Techniques) is a project funded by ANR within its programme “Systèmes Embarqués et Grandes Infrastructures - ARPEGE”. It aims at verification techniques of C programs, and is partly a follow-up of the former CAT project. It started in January 2009 and will end in 2012.

The main goal of the project is to integrate various analysis techniques in a single framework, and make them cooperate in a sound way. We address the following general issues:

- Verification techniques for floating-point programs;
- Specification and verification of dynamic or temporal properties;
- Combination of static analysis techniques;
- Management of verification sessions and activities;
- Certification of the tools chains for compilation and for verification.
Partners: CEA-List (Saclay, project leader), Lande team (INRIA Rennes), Gallium team (INRIA Rocquencourt), Dassault Aviation (Saint-Cloud), Airbus France (Toulouse), ATOS Origin (Toulouse), CNAM Cedric laboratory (Evry), CS Communication & Systems (Toulouse), Hispano-Suiza/Safran (Moissy-Cramayel).

8.2.2. INRIA ADT Alt-Ergo

Participants: Sylvain Conchon [contact], Evelyne Contejean, Claude Marché, Alain Mebsout, Mohamed Iguernelala.

The ADT (Action de Développement Technologique) Alt-Ergo is a 2-years project funded by INRIA, started in September 2009.

The goal is the maturation of the Alt-Ergo prover towards its use in an industrial context in particular for avionics. The expected outcomes of this ADT are the following:

- improving the efficiency of Alt-Ergo;
- fine tuning of Alt-Ergo for the SMT competition;
- generation of counter-examples;
- the qualification of Alt-Ergo for the norm DO-178B.

External Collaborators: Airbus France (Toulouse), Dassault Aviation (Saint-Cloud), team Typical (INRIA, École Polytechnique).

8.2.3. FOST

Participants: Sylvie Boldo [contact], Jean-Christophe Filliâtre, Guillaume Melquiond.

FOST (Formal prOofs of Scientific compuTation programs) is a 3 years ANR “Blanc” project started in January 2009. S. Boldo is the principal investigator of this project. http://fost.saclay.inria.fr

The FOST project follows CerPAN’s footprints as it aims at developing new methods to bound the global error of a numerical program. These methods will be very generic in order to prove a large range of numerical analysis programs. Moreover, FOST aims at providing reusable methods that are understandable by non-specialists of formal methods.

Partners: University Paris 13, INRIA Paris - Rocquencourt (Estime).

8.2.4. SCALP

Participants: Christine Paulin-Mohring [contact], David Baelde, Xavier Urbain.

This project is funded by ANR (program SESUR). http://scalp.gforge.inria.fr/

It started on January 2008 for 4 years; the coordinator is Yassine Lakhnech from VERIMAG.

The SCALP project (Security of Cryptographic Algorithms with Probabilities) aims at developing automated tools for the verification of cryptographic systems.

Partners: Verimag, INRIA Sophia-Antipolis(Everest then Marelle team), ENS Lyon, LRI, CNAM.

8.2.5. DECERT

Participants: Sylvain Conchon, Évelyne Contejean, Stéphane Lescuyer.

DECERT (DEduction and CERTification) is an ANR “Domaines Emergents” project. It started on January 2009 for 3 years; the coordinator is Thomas Jensen from the Lande team of IRISA/INRIA Rennes.

The goal of the project DECERT is to design and implement new efficient cooperating decision procedures (in particular for fragments of arithmetics), to standardize output interfaces based on certificates proof objects and to integrate SMT provers with skeptical proof assistants and larger verification contexts such as the Rodin tool for B and the Frama-C/Jessie tool chain for verifying C programs.

The partners are: CEA List, LORIA/INRIA Nancy - Grand Est, IRISA/INRIA Rennes - Bretagne Atlantique, INRIA Sophia Antipolis - Méditerranée, Systerel
8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

8.3.1.1. FoVeOOS

**Participants:** Claude Marché [contact], Romain Bardou, François Bobot, Asma Tafat.


Project title: Formal Verification of Object-Oriented Software

Duration: May 2008 - April 2012

Coordinator: B. Beckert, University Karlsruhe, Germany

Other partners: 40 academic groups among 18 countries in Belgium, Denmark, Estonia, France, Germany, Ireland, Israel, Italy, The Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland and United Kingdom.

Abstract: The aim of this action is to develop verification technology with the reach and power to assure dependability of object-oriented programs on industrial scale.

8.4. International Initiatives

8.4.1. Visits of International Scientists

- D. Ishii (National Institute of Informatics, Japan) visited the team for 8 months to work on applying program verification methods to hybrid systems.

8.4.2. Supervision of Post-docs and Internships

- S. Boldo supervised the 6-month post-doc intern of E. Makarov (from University of Vermont, USA) about numerical analysis proofs in higher dimensions.

- C. Marché supervised the post-doc intern of K. Krishnamani (from University of Trento, Italy) until August: predicate abstraction techniques for critical C programs ([38] [http://proval.lri.fr/agen](http://proval.lri.fr/agen)).


- S. Conchon supervises the post-doc intern of D. Cousineau since October 2011: interpretation of Alt-Ergo’s proof traces in the Coq proof assistant.

- C. Paulin supervised the internship of N. Gaspar (Universidade da Beira Interior, Portugal) from January to September 2011. He studied the formal proof of concurrent programs using a rely-guarantee approach.

- E. Contejean, together with V. Benzaken (LRI), supervise the internship of S. Yuan (Zhejiang University, China) from October 2011 to March 2012: Automated constraints verification for databases with SMT solvers.

8.4.3. Participation In International Programs

C. Paulin is the representative of Univ. Paris-Sud for the education part of the EIT KIC ICT Labs. She contributed to the proposition of two master programs as well as the action on weaving Innovation and Entrepreneurship in Doctoral programs and the preparation of the SummerSchool “Imagine the future in ICT”.

7. Partnerships and Cooperations

7.1. Disc: Distributed Supervisory Control of Large Plants

**Participant:** Philippe Darondeau.

*ICT STREP 224498 Disc (September 2008 to December 2011), http://www.disc-project.eu*

Started on 1 September 2008, Disc is a project supported by the ICT program of the European Union. The aim of the project is to enable the supervisory control of networked embedded systems. These distributed plants are composed by several local agents that take concurrently decisions, based on information that may be local or received from neighbouring agents; they require scalable and self-organising platforms for advanced computing and control. The evolution is guided by the occurrence of asynchronous events, as opposed to other real-time models where the event occurrence is time-triggered.

The partners of the project come from academia (University of Cagliari, CWI - Amsterdam, Ghent University, Technical University of Berlin, University of Zaragoza, INRIA, Czech Academy of Sciences), from industry (Akhela s.r.l., Italy and CyBio AG, Germany), and from a governmental instance (Ministry of the Flemish Government, Belgium).

Philippe Darondeau has worked in this context with Eric Badouel, Anne Bouillard and Jan Komenda (Czech Academy of Sciences, Brno) on the synthesis of robust delay-controllers for timed systems modelled with rational power series. He works also towards applying the synthesis of distributable Petri nets to asynchronous and distributed supervisory control.

7.2. Synchronics: Language Platform for Embedded System Design

**Participants:** Albert Benveniste, Timothy Bourke, Benoît Caillaud.

*Large initiative action funded by INRIA. http://synchronics.inria.fr/*

This project, started Jan 1st 2008, is supported by INRIA. It capitalizes on recent extensions of data-flow synchronous languages (mode automata, Lucid Synchrone, Signal, Lustre, ReactiveML, relaxed forms of synchronous composition or compilation techniques for various platforms). We aim to address the main challenges of embedded system design, starting from a single, semantically well founded programming language.

Our contribution in 2011 is detailed in Section 6.2. A detailed account of the work carried out in Synchronics can be found in the slides presented during the mid-term evaluation seminar of the action: http://synchronics.inria.fr/doku.php/mid-term-review
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR Jeunes Chercheurs “CAC”

Participants: L. Perret [contact], J.-C. Faugère, G. Renault.

The new contract CAC “Computer Algebra and Cryptography” begins in October 2009 for a period of 4 years. This project will investigate the areas of cryptography and computer algebra, and their influence on the security and integrity of digital data. In CAC, we plan to use basic tools of computer algebra to evaluate the security of cryptographic schemes. CAC will focus on three new challenging applications of algebraic techniques in cryptography; namely block ciphers, hash functions, and factorization with known bits. To this hand, we will use Gröbner bases techniques but also lattice tools. In this proposal, we will explore non-conventional approaches in the algebraic cryptanalysis of these problems.

8.2. ANR “HPAC”

Participants: J.-C. Faugère [contact], L. Perret, G. Renault, M. Safey El Din.

The pervasive ubiquity of parallel architectures and memory hierarchy has led to a new quest for parallel mathematical algorithms and software capable of exploiting the various levels of parallelism: from hardware acceleration technologies (multi-core and multi-processor system on chip, GPGPU, FPGA) to cluster and global computing platforms. For giving a greater scope to symbolic and algebraic computing, beyond the optimization of the application itself, the effective use of a large number of resources (memory and specialized computing units) is expected to enhance the performance multi-criteria objectives: time, resource usage, reliability, even energy consumption. The design and the implementation of mathematical algorithms with provable, adaptive and sustainable performance is a major challenge. In this context, this project is devoted to fundamental and practical research specifically in exact linear algebra and system solving that are two essential “dwarfs” (or "killer kernels") in scientific and algebraic computing. The project should lead to progress in matrix algorithms and challenge solving in cryptology, and should provide new insights into high performance programming and library design problems.

8.3. ANR “GeoLMI”

Participants: J.-C. Faugère, M. Safey El Din [contact].

The GeoLMI project aims at developing an algebraic and geometric study of linear matrix inequalities (LMI) for systems control theory. It is an interdisciplinary project at the border between information sciences (systems control), pure mathematics (algebraic geometry) and applied mathematics (optimisation). The project focuses on the geometry of determinantal varieties, on decision problems involving positive polynomials, on computational algorithms for algebraic geometry, on computational algorithms for semi-definite programming, and on applications of algebraic geometry techniques in systems control theory, namely for robust control of linear systems and polynomial optimal control.

8.3.1. European Initiatives

8.3.1.1. ECRYPT II - European Network of Excellence for Cryptology

Participants: J.C. Faugère [contact], L. Perret, G. Renaul, L. Bettale.

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2 http://hpac.gforge.inria.fr/
3 http://homepages.laas.fr/henrion/geolmi/
ECRYPT II - European Network of Excellence for Cryptology II is a 4-year network of excellence funded within the Information & Communication Technologies (ICT) Programme of the European Commission’s Seventh Framework Programme (FP7) under contract number ICT-2007-216676. It falls under the action line Secure, dependable and trusted infrastructures. ECRYPT II started on 1 August 2008. Its objective is to continue intensifying the collaboration of European researchers in information security. The ECRYPT II research roadmap is motivated by the changing environment and threat models in which cryptology is deployed, by the gradual erosion of the computational difficulty of the mathematical problems on which cryptology is based, and by the requirements of new applications and cryptographic implementations. Its main objective is to ensure a durable integration of European research in both academia and industry and to maintain and strengthen the European excellence in these areas. In order to reach this goal, 11 leading players have integrated their research capabilities within three virtual labs focusing on symmetric key algorithms (SymLab), public key algorithms and protocols (MAYA), and hardware and software implementations associate (VAMPIRE). They are joined by more than 20 adjoint members to the network who will closely collaborate with the core partners. The team joins the European Network of Excellence for Cryptology ECRYPT II this academic year as associate member.

8.3.2. International Initiatives

8.3.2.1. Royal Society Project
Participants: J.C. Faugère [contact], L. Perret, L. Bettale.

Royal Society Project with the Crypto team Royal Holloway, University of London, UK.

8.3.2.2. Joint LIAMA Project ECCA

ECCA (Exact/Certified Computation with Algebraic systems) is a LIAMA project (Reliable Software Theme) focusing on polynomial system solving. The partners are INRIA, CNRS, and CAS (Chinese Academy of Sciences). The general objectives of this project are mainly the same as those of SALSA.

8.3.2.3. ANR International Grant “EXACTA”
Participants: D. Wang [contact], J.-C. Faugère, D. Lazard, L. Perret, G. Renault, M. Safey El Din.

The main objective of this project is to study and compute the solutions of nonlinear algebraic systems and their structures and properties with selected target applications using exact or certified computation. The project consists of one main task of basic research on the design and implementation of fundamental algorithms and four tasks of applied research on computational geometry, algebraic cryptanalysis, global optimization, and algebraic biology. It will last for three years (2010–2012) with 300 person-months of workforce. Its consortium is composed of strong research teams from France and China (KLMM, SKLOIS, and LMIB) in the area of solving algebraic systems with applications.

8.3.3. Scientific Animation

8.3.3.1. Journals – Associate Editors and Program Committees

J.-C. Faugère is member of the editorial board of Journal “Mathematics in Computer Science” (Birkhäuser) and Journal “Cryptography and Communications – Discrete Structures, Boolean Functions and Sequences” (Springer); guest editor for special issues in Journal of Symbolic Computation (Elsevier) and Journal “Mathematics in Computer Science” (Birkhäuser).

M. Safey el Din is member of the editorial board of Journal of Symbolic Computation (Elsevier).

J.-C. Faugère is PC co-chair of the third SCC conference (Santander, 2012).
D. Wang is member of the editorial board of:

- Editor-in-Chief and Managing Editor for the journal “Mathematics in Computer Science” (published by Birkhäuser/Springer, Basel).
- Executive Associate Editor-in-Chief for the journal “SCIENCE CHINA Information Sciences” (published by Science China Press, Beijing and Springer, Berlin).
- Member of the Editorial Boards for the
  - Frontiers of Computer Science in China (published by Higher Education Press, Beijing and Springer, Berlin),
  - Book Series on Mathematics Mechanization (published by Science Press, Beijing),
- Editor for the Book Series in Computational Science (published by Tsinghua University Press, Beijing).

M. Safey El Din was member of the program committees of the 36-th International Symposium on Symbolic and Algebraic Computation (San Jose, USA, June 8–11 2011) and the 13-th International Workshop on Computer Algebra in Scientific Computing (Kassel, Germany, September 5 - 9, 2011) and is member of the program committee of the 13-th International Workshop on Computer Algebra in Scientific Computing (Maribor, Slovenia, September 3 - 6, 2012).

D. Wang was member of the program committee of:

- Technical Session at ICCSA 2011 on Symbolic Computing for Dynamic Geometry (Santander, Spain, June 20–23, 2011).

### Scientific visits and international seminar

M. Safey El Din was invited 2 weeks in July 2011 by L. Zhi at the Key Laboratory of Mechanization and Mathematics (Chinese Academy of Sciences, Beijing China), 1 week at the department of Computer Science at Aarhus University (Denmark), 2 weeks in October 2011 by E. Schost at the Department of Computer Science at The University of Western Ontario (London, Canada). He is a co-organizer of the next National Days of Computer Algebra in 2012.

L. Perret was invited 2 weeks in 2011 (in July and December) by D. Lin at the SKLOIS (Chinese Academy of Sciences, Beijing China), 1 week (April, 2011) at the Stevens Institute (New-York, USA) by A. Miasnikov. J.-C. Faugère was invited 1 week in July 2011 by D. Lin at the SKLOIS (Chinese Academy of Sciences, Beijing China).

### Conferences (organization) and invited talks

J.-C. Faugère was plenary invited speaker at ECC 2011, the 15th workshop on Elliptic Curve Cryptography. J.-C. Faugère is member of the MEGA Advisory Board.

M. Safey El Din is co-organizer (with L. Zhi) of the First International Workshop on Certified and Reliable Computing, held in July 2011 at Nanning, China, co-organizer of the mini-symposia on Algebraic Complexity (with E. Schost) and Algorithms in Real Algebraic Geometry (with H. Hong) which have been held on the occasion of the SIAM conference on Applications of Algebraic Geometry (Raleigh, Oct. 2011).
M. Safey El Din was invited speaker at the mini-symposium on Algebraic Geometry and Optimization (SIAM conference on Optimization), the MaGIX conference (LIX, Palaiseau) and gave several talks in the mini-symposia organized during the SIAM Conference on Applications of Algebraic Geometry. He was also invited to give a talk at the joint Mathematics-Computer Science seminar at the University of Western Ontario and gave a talk at the first workshop of the GeoLMI project (Rennes, Nov. 2011).

J.-C. Faugère was invited speaker at the MaGIX conference (LIX, Palaiseau) and in the mini-symposium on Linear Algebra organized during the SIAM Conference on Applications of Algebraic Geometry (Raleigh, USA). He was also invited to give a talk at the joint Mathematics-Computer Science seminar at the University of Aarhus (Danmark).

8.3.3.4. Committees

J.-C. Faugère was a member of the evaluation committee (AERES) of the institut de mathématiques de Toulon et du Var.

M. Safey El Din is a designated member of the French National Council of the Universities (CNU).

J.-C. Faugère is member of the hiring committee in computer science at the <<Université Pierre et Marie Curie>>, <<Université de Toulon>> and <<Université Joseph Fourier>>.

8.3.4. Teaching

J.C. Faugère, L. Perret give a course on Polynomial System Solving, Computer Algebra and Applications at the “Master Parisien de Recherche en Informatique” (MPRI).

G. Renault gives a course on Computational Number Theory and Cryptology at the <<Master d’Informatique de l’Université Paris 6>>.
SECRET Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

- **ANR RAPIDE** (01/07 → 03/11)
  Design and analysis of stream ciphers dedicated to constraint environments
  Partners: LORIA (project-team CACAO/CARAMEL), INRIA (project-team SECRET), INSA Lyon (team Middleware/Security), University of Limoges (XLIM).
  151 kEuros.
  This project focuses on stream ciphers and especially on stream ciphers with an internal state governed by a non-linear transition function. We particularly draw our attention to ciphers whose characteristics make them especially fit constrained environments. The results of the project are practical as well as theoretical and concern both design and analysis of such stream ciphers.

- **ANR DEMOTIS** (02/09 → 02/12)
  Collaborative Analysis, Evaluation and Modelling of Health Information Technology
  ANR program: ARPEGE (Systèmes Embarques et Grandes Infrastructures)
  Partners: Sopinspace, INRIA (project-teams SECRET and SMIS), CNRS/CECOJI
  55 kEuros.
  DEMOTIS brings together computer scientists and legal scholars. The project experiments new methods for the multidisciplinary design of large information systems that have to take in account legal, social and technical constraints. Its main field of application is personal health information systems. Most notably, work is conducted in priority on the infrastructure for the French personal medical file system (DMP) and secondarily on the data infrastructure for the research and public health networks associated with specific diseases (AIDS, cancer). The aim is to understand how the intrication between the legal and technical domains affects the design of such data infrastructures.

- **ANR SAPHIR-2** (03/09 → 03/13)
  Security and Analysis of Primitives of Hashing Innovatory and Recent 2
  ANR program: VERSO (Reseaux du Futur et Services)
  Partners: France Telecom, Gemalto, Cryptolog international, EADS SN, Sagem Securite, ENS/LIENS, UVSQ/PRISM, INRIA (project-team SECRET), ANSSI
  153 kEuros.
  This industrial research project aims at participating to the NIST competition (cryptanalysis, implementations, optimizations, etc.), and in supporting the SHA-3 candidates proposed by its partners.

- **ANR COCQ** (01/09 → 01/12)
  Codes correcteurs quantiques
  ANR program: Domaines emergents
  Partners: ENSEA, INRIA (project-team SECRET), Université de Bordeaux, Telecom ParisTech
  117 kEuros.
  This project deals with the development of fundamental research on error correcting codes for quantum channels. In particular, we aim to suggest suitable generalizations to the quantum setting of the best known families of quantum codes (such as LDPC or turbo-codes) and to analyze their performance.
7.2. European Initiatives

Associate member of the ECRYPT II European network of excellence (08/08 → 07/12) http://www.ecrypt.eu.org/

7.2.1. Major European Organizations with which you have followed Collaborations

Otto-von-Guericke Universität Magdeburg, Institut für Algebra und Geometrie (Germany)
Study of Boolean functions for cryptographic applications

DTU - Danmarks Tekniske Universitet, Department of Mathematics
Symmetric crytography and code-based cryptography

7.3. International Initiatives

7.3.1. Visits of International Scientists

- Gohar Kyureghyan, Otto-von-Guericke Universität Magdeburg, Germany, from October 2011 to June 2012
- Kaisa Nyberg, Aalto University, Finland, November 6-8.
- Christiane Peters, Danmarks Tekniske Universitet, Copenhagen, Denmark, November 13-18.
- Stefan Heyse, Ruhr-Universität Bochum, Germany, November 13-18.

7.3.2. Visits to International Partners

- EPFL, Lausanne, Switzerland, September 1-30, invitation to the Combinatorial, Algebraic and Algorithmic Aspects of Coding Theory Program of the Centre interfacultaire Bernoulli, (N. Sendrier)
- EPFL, Lausanne, Switzerland, September 7-15, invitation to the Combinatorial, Algebraic and Algorithmic Aspects of Coding Theory Program of the Centre interfacultaire Bernoulli, (P. Charpin)
- EPFL, Lausanne, Switzerland, September 5-29, invitation to the Combinatorial, Algebraic and Algorithmic Aspects of Coding Theory Program of the Centre interfacultaire Bernoulli, (JP. Tillich)
7. Partnerships and Cooperations

7.1. Regional Initiatives


7.2. National Initiatives

  In the context of proofs of safety properties for critical software, The CPP project proposes to study the joint use of probabilistic and formal (deterministic) semantics and analysis methods, in a way to improve the applicability and precision of static analysis methods on numerical programs. See http://www.lix.polytechnique.fr/~bouissou/cpp/index.php.
  Electronic voting promises the possibility of a convenient, efficient and secure facility for recording and tallying votes. However, the convenience of electronic elections comes with a risk of large-scale fraud and their security has seriously been questioned. The AVOTÉ project aims at proposing formal methods to analyze electronic voting protocols. See http://www.lsv.ens-cachan.fr/anr-avote/.
  The goal of the ProSe project is to increase the confidence in security protocols, and in order to reach this goal, provide security proofs at three levels: the symbolic level, in which messages are terms; the computational level, in which messages are bitstrings; and the implementation level: the program itself. This project is a continuation of the FormaCrypt project. See https://crypto.di.ens.fr/projects:prose:main.

7.3. INRIA Actions of Technological Development

- ADT Phalaenopsis, Dec. 2010-Dec. 2011. General improvement of the ORCHIDS tool (user interface, connexion with vulnerability and topology databases, enriching the signature base), and weaving a web of relations with interested industrial and institutional partners. Baptiste Gourdin was hired on this ADT in 2010-2011.

7.4. International Initiatives

7.4.1. Visits of International Scientists

- Olivier Pereira, Université Catholique de Louvain, Belgium, one week, March 2011.
- Mahesh Viswanathan, University of Illinois at Urbana-Champaign, one month, May 2011.

7.4.1.1. Internship
• Jan Degrieck, *Graph Reduction for Analysing Secure Routing Protocols*, advisor Stéphanie Delaune (with co-advisor Véronique Cortier);

• Daniel Pasaila, *Algorithms for Deciding Symbolic Equivalence*, advisors Stéphanie Delaune and Steve Kremer;

8. Partnerships and Cooperations

8.1. Regional Initiatives

- DIGITEO contributed the operational funding for the project AMIGA (Advanced Methods for Isogeny Graph Analysis), with B. Smith as the scientific leader of the project. On a national level, the DGA contributed a postdoctoral salary to the project (see National Initiatives).

8.2. National Initiatives

- The DGA funded a postdoctoral researcher’s salary for Sorina Ionica, allowing her to join TANC for one year (10/2010–09/2011) as a postdoctoral researcher for the AMIGA project.
- The team received DGA funding for the project DIFMAT, joint with ENSTA, to find good MDS matrices, which are used for diffusion in block ciphers. The period is October 2011–September 2012, eventually renewable one year.

8.3. European Initiatives

8.3.1. Major European Organizations with which Tanc has followed Collaborations

Partner 1: Ulm Universität, TAIT group, Germany.
Subject 1: bridging Ulm’s unique decoding with Guruswami-Sudan list decoding. Funded by a PHC Hubert Curien.

8.4. International Initiatives

8.4.1. INRIA International Partners

- DTU, Denmark.

8.4.2. Visits of International Scientists

- Kamal Khuri–Makdisi, American University of Beirut, two weeks.
- Iwan Duursma, University of Illinois at Urbana Champaign, two weeks.
8. Partnerships and Cooperations

8.1. Regional Initiatives

The goal of Ligéro is to create an internationally visible regional research group putting together the key actors in the domain of Operations Research in the Pays de la Loire region.

8.2. National Initiatives

- Cooperation with J.-C. Régis from Univ. Nice on efficient filtering algorithms (3 papers in 2011).
- Cooperation with A. Miné from ENS Paris on abstract domains by M. Pelleau and C. Truchet (2 visits in Paris).

8.3. European Initiatives

- Cooperation with P. Van Hentenryck from Univ. Brown (USA) for the supervision of the PhD of M. Pelleau (1 visit in Nantes).
- Cooperation with P. Flener from Univ. Uppsala (Sweden) on automata, invited (3 visits in Uppsala, 1 visit in Nantes).
- Cooperation with H. Simonis from 4C (Ireland) on the constraint and model seekers (2 visits in Cork, 1 visit in Nantes, 2 papers in 2011).
- Cooperation with M. Carlsson from SICS (Sweden) on the global constraint catalog (negation of automata with and without counters) (1 visit in Uppsala, update of the global constraint catalog in September 2011).
TRIO Project-Team (section vide)
7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Digiteo Paso

Participants: Assia Mahboubi, Benjamin Werner [Contact].

The PASO project (Preuves, Interprétation abstraite, and Optimisation cal properties of programs, arising in particular from the modeling of complex systems with critical security issues. It gathers computer scientists from CEA-LIST/MeASI, INRIA Saclay/Typical and LIX and specialists from Optimization or Control theory from LIX/MeASI, INRIA Saclay/Maxplus and CMAP, and Supelec/L2S. The goal of this exploratory project is to cross-fertilize these fields, by applying advanced algorithms or techniques inspired by global optimization, by the analysis and identification of dynamical systems, or by zero-sum game theory, in order to improve the precision or the scalability of current methods in proof and static analysis. These applications coming from computer science turn out to raise new challenges for the applied mathematicians. The project started in October 2008 and ended in November 2011.

7.1.2. Digiteo Coquelicot

Participant: Assia Mahboubi [Contact].

Coquelicot is a 3 years Digiteo project that started in September 2011. Sylvie Boldo (INRIA, project-team ProVal) is the principal investigator of this project. The Coquelicot project aims at creating a modern formalization of the real numbers in Coq, with a focus on practicality. This is sorely needed to ease the verification of numerical applications, especially those involving advanced mathematics.

7.2. National Initiatives

7.2.1. ANR DeCert

Participants: Germain Faure, Chantal Keller, Assia Mahboubi [Contact].

This project is funded by the call Domaines Emergents 2008, a program of the Agence Nationale de la Recherche. It started in January 2009 and will end in December 2012. The objective of the DECERT project is to design an architecture for cooperating decision procedures, with a particular emphasis on fragments of arithmetic, including bounded and unbounded arithmetic over the integers and the reals, and on their combination with other theories for data structures such as lists, arrays or sets. To ensure trust in the architecture, the decision procedures will either be proved correct inside a proof assistant or produce proof witnesses allowing external checkers to verify the validity of their answers.

7.2.2. ANR PSI

Participants: Germain Faure, Assia Mahboubi [Contact], Revantha Ramanayake.

This project is is funded by the call Jeunes Chercheurs Jeunes Chercheuses 2009, a program of the Agence Nationale de la Recherche. It started in September 2009 and will end in September 2013. The PSI project aims at investigating how to take into account the specificities of a given theory when designing proof search methods, both in the theory of proof search and in the design of automated tools.

7.2.3. ANR Paral-ITP

Participants: Bruno Barras [Local coordinator for Inria Saclay – Île - de - France], Germain Faure, Assia Mahboubi, Enrico Tassi.
This project is funded by the call Ingénierie Numérique et Sécurité 2011, a program of the Agence Nationale de la Recherche. The Paral-ITP project intends to overcome the sequential model for Coq, to make the resources of multi-core hardware available for even larger proof developments. Beyond traditional processing of proof scripts as sequence of proof commands, there is a large space of possibilities and challenges for pervasive parallelism. Coq shall be connected to a uniform document model that integrates parallel and asynchronous evaluation processes with notions of history and change management, over the rich structure of formal content. This can then serve as a basis for an editor document model in direct user interaction, and background library management with continuous proof checking, in the style of modern IDEs like Eclipse or Netbeans. Ultimately, the general document model and front-end technology will accommodate end-users and builders of add-on tools. One typical instance is the add-on that imports proofs constructed by automated deduction systems (SAT and SMT solvers).

7.3. European Initiatives

7.3.1. FP7 Projet

7.3.1.1. FORMATH

Title: FORMATH
Type: COOPERATION (ICT)
Defi: FET Open
Instrument: Specific Targeted Research Project (STREP)
Duration: March 2010 - February 2013
Coordinator: Univ Gothenburg (Sweden)

Others partners: University of Gothenburg, Radboud University Nijmegen, Universidad de la Rioja, INRIA.

See also: FORMATH

Abstract: This project proposes to develop libraries of formalized mathematics concerning algebra, linear algebra, real number computation, and algebraic topology.

7.4. International Initiatives

7.4.1. Visits of International Scientists

7.4.1.1. Internship

Gilles Dowek has been the advisor of Jianhua Gao (University of Tsinghua, Beijing, China), who spent a year in Paris as part of its Doctoral degree.
8. Partnerships and Cooperations

8.1. National Collaborations

Additionally, we collaborated in 2011 with the following INRIA project teams:

- **OASIS** (Sophia-Antipolis): distributed verification tools (Eric Madelaine);
- **POP-ART** (Rhône-Alpes): behavioral adaptation of software services and conformance checking of choreography specifications (Gregor Gössler);
- **SARDES** (Rhône-Alpes): verification of protocols for component-based architectures and virtualization (Fabienne Boyer, Olivier Gruber, and Noël de Palma).

Beyond INRIA, we had sustained scientific relations with the following researchers:

- Gaëlle Calvary and Sophie Dupuy (LIG, Grenoble);
- Pascal Poizat (LRI, Orsay);
- Meriem Ouederni (LINA, Nantes);
- Xavier Blanc and Cédric Teyton (LABRI, Bordeaux).

8.2. European Collaborations

The VASY project team is member of the FMICS (Formal Methods for Industrial Critical Systems) working group of ERCIM (see http://fmics.inria.fr). From July 1999 to July 2001, H. Garavel chaired this working group; since July 2002, he has been a member of the FMICS Board, and is in charge of dissemination actions. In November 2011, R. Mateescu was elected chairman of the FMICS working group.

In addition to our partners in aforementioned contractual collaborations, we had scientific relations in 2011 with several European universities and research centers, including:

- Polytechnic University of Bucharest (Valentin Cristea);
- Saarland University (Jonathan Bogdoll, Pepijn Crouzen, Arnd Hartmanns, and Holger Hermanns);
- University of Coimbra (Javier Camara);
- University of Málaga (Carlos Canal, Meriem Ouederni, and Ernesto Pimentel).

D. Thivolle defended his PhD thesis at the Polytechnic University of Bucharest on April 29, 2011.

Our long-term partnership with Saarland University has been strengthened by the Humboldt Forschungspreis received by H. Garavel, who started regular visits to Saarland University.

H. Garavel has participated in the review of the DFG (Deutsche Forschungsgemeinschaft) transregional project AVACS (Automatic Verification And Analysis of Complex Systems, see http://www.avacs.org) on September 14–15, 2011.

8.3. International Collaborations

H. Garavel is a member of IFIP (International Federation for Information Processing) Technical Committee 1 (Foundations of Computer Science) Working Group 1.8 on Concurrency Theory chaired successively by Luca Aceto and Jos Baeten.
8.4. Visits and Exchanges

In 2011, we had the following scientific exchanges:

- Nicolas Halbwachs (VERIMAG) visited us on January 28, 2011 and gave a talk entitled “Analyse de programmes: propriétés numériques et tableaux”.
- Thomas Lambolais and Thanh-Liem Phan (Ecole des Mines d’Alès) visited us on February 9, 2011.
- Meriem Ouederni (University of Málaga, Spain) visited us from June 27 to July 1, 2011 and from November 21 to November 25, 2011.
- Freark van der Berg (University of Twente, The Netherlands) visited us on October 17–21, 2011.
- Farhad Arbab (CWI, Amsterdam, The Netherlands) visited us on November 22, 2011 and gave a talk entitled “Interaction-Based Concurrency”.
- Gianluigi Zavattaro (University of Bologna, Italy) visited us on November 22, 2011 and gave a talk entitled “Parameterized Verification of Ad Hoc Network Protocols”.
- The annual VASY seminar was held in Autrans (France) on November 28–30, 2011.
- Xavier Blanc (LaBRI, Bordeaux) attended the VASY annual seminar and gave on November 28, 2011 a talk entitled “Vpraxis et évolution d’applications Internet”.
- Christian Attiogbe (LINA, Nantes) attended the VASY annual seminar and gave on November 29, 2011 a talk entitled “Composition dynamique de processus dans les systèmes complexes”.
- Grégory Batt (INRIA Rocquencourt) attended the VASY annual seminar and gave on November 30, 2011 a talk entitled “A general computational method for robustness analysis with applications to synthetic gene networks”.
- Holger Hermanns (Saarland University) visited us on December 1st, 2011 and gave a LiG keynote entitled “From Concurrency Models to Numbers: Performance, Dependability, Energy”.

VEGAS Project-Team (section vide)
8. Partnerships and Cooperations

8.1. European Initiatives

8.1.1. Cooperation with NUI Maynooth, Ireland

We are involved in a bilateral research project with the National University of Ireland at Maynooth, funded by the Ulysses program between France and Ireland. The project addresses the question of formally verifying safety critical properties of software control systems, guaranteeing their reliability and safety. In particular, we address the following questions: What is the best methodology for generating a formal system requirements document (written in Event-B) for an already existing tram control system? What is the relationship between Event-B and Programmable Logic? How effectively can we support the formal translation of a system specification written in Event-B to its implementation written in programmable logic? Can we demonstrate that this formal transformation preserves the safety critical properties as specified for an existing tram control system? A combination of reverse engineering and refinement techniques are used to prove the safety critical properties of a tram control system, generating a suite of proof based patterns that may be used in the verification of safety critical properties of similar systems. Case studies involving subsystems of the tram control system will be used to develop Master level courses, ensuring technology transfer between industry and the classroom, and vice versa. Visits of Dominique Méry in February, August and December led to a series of lectures in the master program and in a Summer School organised by NUI Maynooth; Dominique Méry is completing models for ensuring the quality of produced codes. During a reciprocal visit of Rosemary Monahan of NUI Maynooth in October, she gave a tutorial on the verification of C# programs using Spec# and Boogie 2.

8.2. International Initiatives

8.2.1. INRIA International Partners

8.2.1.1. Cooperation with Universidade Federal do Rio Grande de Norte, Brazil

VeriDis has a close working relationship with a team at Universidade Federal do Rio Grande de Norte (UFRN), Brazil, and more particularly with Prof. Anamaria Martins Moreira and Prof. David Déharbe. Two long exchanges took place in 2011. Bruno Woltzenlogel Paleo visited UFRN for one month in March, and David Déharbe visited VeriDis from June 20 to July 20 as an INRIA invited researcher. The project is centered around the development and applications of the veriT solver (section 5.1 ), of which David Déharbe and Pascal Fontaine are the main developers. Diego Caminha was previously a student at UFRN and prepared his PhD thesis with the VeriDis team. Our cooperation is also supported by the INRIA-CNPq project SMT-SAVeS from 2010 throughout 2012.

8.2.1.2. Cooperation with Tiaret University

Mostapha Belardi (Université Ibn Khaldoun de Tiaret), Camel Tanougast (Univ. Paul Verlaine, Metz), Dominique Méry and Stephan Merz have started a joint project entitled CIPRONoC : Conception Incrémentale Prouvée pour pROtotypage rapide de NoC Tolérant aux Fautes à base de technologie FPGA. The project is sponsored by the STIC Algérie program.

8.2.2. Visits of International Scientists

8.2.2.1. INRIA Internship program

Hernán Ponce de Leon (from April 2011 until August 2011)

Subject: Formally Verified Automata Construction for Real Linear Equations
Institution: Universidad Nacional de Rosario (Argentina)
8.2.2.2. Invited scientists

David Déharbe from Universidade Federal do Rio Grande de Norte, Brazil, visited VeriDis from June 20 to July 20 as an INRIA invited researcher. The work resulted in several improvements of the veriT solver and contributed to its integration within the toolsets for the B and TLA$^+$ methods.
7. Partnerships and Cooperations

7.1. National initiatives

7.1.1. ANR TesTec: Test of real-time and critical embedded system

Participants: Nathalie Bertrand, Thierry Jéron, Hervé Marchand.

The TesTec project is a three years [2008-2010] industrial research project that gathers two companies: an end-user (EDF R&D ) and one software editor for embedded real-time systems and automation systems (Geensys), and four laboratories from automation engineering and computer science (I3S, INRIA Rennes, LaBRI, LURPA). This project focuses on automatic generation and execution of tests for the class of embedded real-time systems. They are highly critical. Such systems can be found in many industrial domains, such as energy, transport systems. More precisely the project TesTec will address two crucial technological issues:

- optimisation of test generation techniques for large size systems, in particular by an explicit modelling of time and by simultaneous management of continuous and discrete variables in hybrid applications;
- reduction of the size of the tests derived from specification models by using the results of formal verification of implementation models.

The overall aim of this project is to propose a software tool for generation and execution of tests; this tool will be based on an existing environment for embedded systems design and will implement the scientific results of the project.

This year our contributions to this project were our works on test generation from timed models, as well as approximate determinization of timed models.

In 2011, the post-doc position of Puneet Bhateja was funded by TestTec.

7.1.2. ANR VACSIM: Validation of critical control-command systems by coupling simulation and formal analysis

Participants: Nathalie Bertrand, Thierry Jéron, Hervé Marchand.

The Vacsim project (2011-2014) is a 3 years project with EDF R&D, Dassault Systèmes, LURPA Cachan, I3S Nice and Labri Bordeaux. The project aims at developing both methodological and formal contributions for the simulation and validation of control-command systems. The rôle of the Vertecs team will be to contribute to the advance of validation techniques for timed systems, including quantitative analysis and its application to testing, monitoring of timed systems, and verification of communicating timed automata.

7.1.3. Action Incitative VeSPa: Verification of security and privacy properties

Participant: Nathalie Bertrand.

The VeSPa "Action Incitative" is a one-year [2011] project funded by Rennes 1 University to develop emerging research themes. The goal of the project is to strat and verify security and privacy properties in protocols, using logic and games techniques. The participants are Sophie Pinchinat (leader, S4), Sébastien Gambs (Cidre), Guillaume Aucher (DistribCom), and Nathalie Bertrand (Vertecs). To gather researchers interested in the topic, the second edition of a workshop on Games, Logics and Security has been organized in October 2011.
7.2. European initiatives

7.2.1. Artist design network of excellence

**Participants:** Nathalie Bertrand, Thierry Jéron, Hervé Marchand.

**Program:** FP7  
**Project acronym:** Artist Design  
**Project title:** Artist - European Network of Excellence on Embedded System Design  
**Duration:** 01/08 - 12/11  
**Coordinator:** VERIMAG  

**Abstract:** The central objective for ArtistDesign [http://www.artist-embedded.org/artist/-ArtistDesign-Participants-.html](http://www.artist-embedded.org/artist/-ArtistDesign-Participants-.html) is to build on existing structures and links forged in Artist2, to become a virtual Center of Excellence in Embedded Systems Design. This will be mainly achieved through tight integration between the central players of the European research community. Also, the consortium is smaller, and integrates several new partners. These teams have already established a long-term vision for embedded systems in Europe, which advances the emergence of Embedded Systems as a mature discipline.

The research effort aims at integrating topics, teams, and competencies, grouped into 4 Thematic Clusters: “Modelling and Validation”, “Software Synthesis, Code Generation, and Timing Analysis”, “Operating Systems and Networks”, “Platforms and MPSoC”. “Transversal Integration” covering both industrial applications and design issues aims for integration between clusters.

The Vertecs EPI is a partner of the “Validation” activity of the “Modeling and Validation” cluster. This year, the Vertecs EPI has contributed to quantitative verification of timed automata [15], approximate determinization of timed automata [18] and its adaptation to test generation [17], and control synthesis using abstract interpretation for infinite state systems [11], on decentralized [10] and distributed control [21], [22]. Amélie Stainer spent one month in Aalborg to implement the approximate determinization of timed automata using UPPAAL libraries.

7.2.2. PHC Tournesol STP : Verification of timed and probabilistic systems

**Participants:** Nathalie Bertrand, Amélie Stainer.

A two-year contract with the group of Thomas Brihaye (Université Mons) started in 2010. Its objective is to study timed and probabilistic systems. This year, Nathalie Bertrand visited Thomas Brihaye in Mons, and Thomas Brihaye came to Rennes to give a seminar and further discuss with Nathalie Bertrand and Amélie Stainer.

7.2.3. Followed collaborations with major European organizations

- Université Libre Bruxelles (Belgium), Prof. Thierry Massart
- Testing and control of symbolic transitions systems
- University of Kaiserslautern (Germany), Roland Meyer
- Petri nets
- University of Dresden (Germany), Prof. Christel Baier
- Probabilistic automata over infinite words

7.3. International Initiatives

7.3.1. INRIA associate team

7.3.1.1. TREATIES
Title: Test of Real-Time Embedded Systems
INRIA principal investigator: Thierry Jéron
International Partner:
  Institution: Federal University of Campina Grande (Brazil)
  Laboratory: Universidade Federal do Campina Grande

Duration: 2009 - 2011
See also: http://www.irisa.fr/vertecs/Treaties.html

This associated team with the Federal University of Campina Grande (Prof. Patrícia D. L. Machado) and University Pernambuco (Prof. Augusto Sampaio) in Brazil started in 2009 and ended this year.

In 2011 Nathalie Bertrand and Sébastien Chédor visited the Brazilian team in Recife in November where a meeting took place, and we had the visit of Wilkerson Andrade in November.

This year the cooperation addressed problems in test generation for timed input/output symbolic transition systems (see 6.2.5 ) and compositional conformance verification for these models, on the problems of non-determinism in timed models for test generation (see 6.1.2.1 and 6.2.1 ), on test vector generation for timed models, and automatic test case generation and execution for regular graphs (see 6.2.2 ).

7.3.2. INRIA international partners

University of Michigan (Prof. Stéphane Lafortune) on control and diagnosis of discrete event systems.

7.3.3. Visits of international scientists

Laurie Ricker, associate professor at the Mathematics & Computer Science department of Mount Allison University (Canada) has visited Vertecs for 6 months, from January 2011 to June 2011. We collaborate on control of discrete event systems for distributed systems.
7. Partnerships and Cooperations

7.1. Regional Initiatives

The project PSI (Psychology and sounds interactions), headed by P. Legrand received a grant by the region Aquitaine for a PhD thesis on “Dimension reduction in supervised learning. Application to the study of brain activity”.

7.2. National Initiatives

7.2.1. ANR Propagation (2010-2012)

To combat dramatic event such as happened in Bombay last year (coming from the sea, a terrorist commando killed more than 200 peoples in Bombay city), authorities are decided to deploy efficient sea surveillance system to protect coastal zone including sensitive infrastructures often in vicinity of important cities.

Regulation on frequencies allocation and on coastal constructions is strong constraint to be taken into account to install technical capabilities to permanently survey vulnerable littoral zones. For example, new active sensor shall be frequencies compatible within numerous existing ones in inhabited region. In this context to perform coastal surveillance, attractive solution is to deploy passive sensors networks because:

- Not necessarily compatible within existing active sensors network.
- Provide large possibilities to install the passive sensors, because, it is not needed to be on the shoreline, but can be deployed inside the territory. Such as facility offers more potential sites and then, to optimise the deployment for optimal coverage of the sensitive zone.
- Is totally undetectable by external technical means in hand of structured criminal organisations.

For these objectives, the PROPAGATION project will study, develop and experiment a demonstrator to carry out maritime traffic picture from a set of passive sensors: passive radar, AIS and optronic cameras deployed over a coastal site. This is a joint ANR project with DCNS, Thalès, Ecomer and Exavision, accepted in 2009.

7.2.2. Project PEPII

This is an interdisciplinary exploratory research project, between Institut de Mathématiques de Bordeaux and Laboratory Ecologie & Evolution, UMR 7625 CNRS-UMPC-ENS (responsible: B. Cazelles). The objective of this project on the dynamics of epidemic diseases characterized by multiple strains of pathogens, is to use the competencies of the ALEA team to get efficient Bayesian optimization techniques. An opening workshop on stochastic models and bayesian inference in epidemiology has been organized in Bordeaux in November 2011.

7.3. European Initiatives

7.3.1. Major European Organizations with which you have followed Collaborations

- Partner 1: Oxford University, Department of Statistics (UK)
  Interacting Particle Systems
  Bayesian nonparametrics

- Partner 2: Imperial College, Department of Statistics (UK)
  Interacting Particle Systems
7.4. International Initiatives

7.4.1. Visits of International Scientists

The following researchers visited the Team ALEA during 2011: M. Ludkovski (Univ. UCSB), A. Doucet (Univ. Oxford), C. Holmes (Oxford), C. Archambeau (Xerox), N. Whiteley (Univ. Bristol), S. Singh (Cambridge), L. Bornn (UBC), Leonardo Trujillo (Cicese).
APICS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Apics collaborates with the CEA-IRFM (Cadarache), through a grant with the Région PACA, for the thesis of Y. Fischer.

Apics is part of the regional working group SBPI (Signal, Noise, Inverse Problems), with teams from Observatoire de la Côte d’Azur and Géoazur (CNRS) http://www-sop.inria.fr/apics/sbpi.

8.2. National Initiatives

8.2.1. ANR project “AHPI”

AHPI (Analyse Harmonique et Problèmes Inverses), is a “Projet blanc” in Mathematics involving Inria-Sophia (L. Baratchart coordinator), the Université de Provence (LATP, Aix-Marseille), the Université Bordeaux I (LATN), the Université d’Orléans (MAPMO), Inria-Bordeaux and the Université de Pau (Magique 3D). It aims at developing Harmonic Analysis techniques to approach inverse problems in seismology, electroencephalography, tomography and nondestructive control.

8.2.2. ANR project “Filipix”

Filipix (FLtering for Innovative Payload with Improved fleXibility) is a “Projet Thématique en Télécommunications”, involving Inria-Sophia (Apics), XLim, Thales Alenia Space (Centre de Toulouse, coordinator).

8.3. European Initiatives

8.3.1. Major European Organizations with which you have followed Collaborations

APICS is part of the European Research Network on System Identification (ERNSI).

Subject: System identification concerns the construction, estimation and validation of mathematical models of dynamical physical or engineering phenomena from experimental data.

8.4. International Initiatives

8.4.1. INRIA International Partners

NSF CMG collaborative research grant DMS/0934630, “Imaging magnetization distributions in geological samples”, with Vanderbilt University and the MIT (USA).

Cyprus NF grant “Orthogonal polynomials in the complex plane; distribution of zeros, strong asymptotics and shape reconstruction.”
8.4.2. Visits of International Scientists

- Yannick Privat (CNRS, ENS Cachan, antenne Bretagne).
- Tao Qian (University of Macau)
- Nikos Stylianopoulos (University of Cyprus).
- Maxim Yattselev (University of Oregon at Eugene).
- Bernard Hanzon and Conor Sexton (University of Cork).
- Ralf Peeters (University of Maastricht).
- Smain Amari (Royal Military College of Canada).
- Matteo Oldoni (Polytech Milan, Italy)
- Maher Moakher and Moncef Mahjoub (LAMSIN-ENIT, Tunis).
- Alex L. Castro (PUc, Rio de Janeiro)
- Olivier Cots (ENSIEEHT, Toulouse)
- Natalya Shcherbakova (ENSIEEHT, Toulouse)
- Edward Saff (Vanderbilt University)

8.5. Community service

L. Baratchart is Inria’s representative at the « conseil scientifique » of the Univ. Provence (Aix-Marseille). He was a member of the “Comité de sélection” of the Univ. of Bordeaux I (section 25). He is a member of the program committee of SYSID 2012 and MTNS 2012.

S. Chevillard and J. Grimm are representatives at the « comité de centre » (Research Center INRIA-Sophia).

S. Chevillard is representative of the « comité de centre » at the « comité des projets » (Research Center INRIA-Sophia).

J. Leblond was a member of the « Commission d’Évaluation » (CE) of INRIA, until June, and since then, of the “Conseil Scientifique” (CS). Within the Research Center, she is a member of the « Commission d’Animation Scientifique » (CAS-MASTIC) and holds (since March) a supporting task for the researchers.

M. Olivi is a member of the CSD (Comité de Suivi Doctoral) of the Research Center. She is responsible for scientific mediation until July.

J.-B. Pomet is the president of “Commission de Suivi Doctoral” of INRIA Sophia Antipolis. J.-B. Pomet was a representative at the « comité technique paritaire » (CTP) of INRIA until September.

F. Seyfert is a member of the CUMIR.
ASPI Project-Team (section vide)
8. Partnerships and Cooperations

8.1. International Initiatives

8.1.1. INRIA Associate Teams

8.1.1.1. AQUARIUS

Title: Uncertainty quantification and numerical simulation of high Reynolds number flows
INRIA principal investigator: Pietro Marco Congedo
International Partner:
  Institution: Stanford University (United States)
  Laboratory: Department of Mechanical Engineering
  Researcher: Gianluca Iaccarino
International Partner:
  Institution: Stanford University (United States)
  Laboratory: Department of Aeronautics and Astronautics
  Researcher: Charbel Farhat
Duration: 2011 - 2013
See also: http://www.stanford.edu/group/uq/aquarius/index3.html

This research project deals with uncertainty quantification and numerical simulation of high Reynolds number flows. It represents a challenging study demanding accurate and efficient numerical methods. It involves the INRIA team BACCHUS and the groups of Pr. Charbel Farhat from the Department of Aeronautics and Astronautics and Pr. G. Iaccarino from the Department of Mechanical Engineering at Stanford University. The first topic concerns the simulation of flows when only partial information about the physics or the simulation conditions (initial conditions, boundary conditions) is available. In particular we are interested in developing methods to be used in complex flows where the uncertainties represented as random variables can have arbitrary probability density functions. The second topic focuses on the accurate and efficient simulation of high Reynolds number flows. Two different approaches are developed (one relying on the XFEM technology, and one on the Discontinuous Enrichment Method (DEM), with the coupling based on Lagrange multipliers). The purpose of the proposed project is twofold: i) to conduct a critical comparison of the approaches of the two groups (Stanford and INRIA) on each topic in order to create a synergy which will lead to improving the status of our individual research efforts in these areas; ii) to apply improved methods to realistic problems in high Reynolds number flow.

Within this project, several visits have been done (Pietro Marco Congedo in Stanford during May 2011, Arnaud Krust in Vancouver during June 2011, Per Pettersson (PhD student in Stanford) in Bordeaux at INRIA during July 2011, Gianluca Geraci in Stanford during November 2011, Arnaud Krust in Stanford during November 2011, Catherine Gorle (Post-doc scientist in Stanford) in Bordeaux at INRIA during November 2011).

8.1.2. INRIA International Partners

In the context of the MORSE associate team (Matrices Over Runtime Systems at Exascale, see http://icl.cs.utk.edu/projectsdev/morse/overview ) managed by Emmanuel Agullo from HIEPACS team, Pierre Ramet initialized a new collaboration with the Jack Dongara team (see http://icl.cs.utk.edu ). Since the building blocks of sparse direct solvers are dense linear algebra kernels, we envisage to write prototype versions of these solvers on top of PLASMA and MAGMA libraries. This is a preliminary step in order to develop a sparse direct solver suitable for cluster of multi-GPU nodes.
8.1.3. Visits of International Scientists

- Jianxian Qiu (Xiamen University, China), one week in November
- Elena Vazquez-Cendon (Universidade de Santiago de Compostela, Spain), one week in November
- François Morency (École de Technologie Supérieure, Montréal, Canada) from June to October.

8.1.3.1. Internship

- Birte Schmidtmann (Kaiserslautern, Germany), from March to July 2011.
- Per Pettersson (PhD student) in Bordeaux at INRIA during July 2011 (2 weeks), funding: AQUARIUS team
- Catherine Gorle (Post-doc scientist in Stanford) in Bordeaux at INRIA during November 2011 (one week), funding: AQUARIUS team
BIPOP Project-Team

8. Partnerships and Cooperations

8.1. European Initiatives

8.1.1. FP7 Project

8.1.1.1. FlexibleRobotBehav

Title: FlexibleRobotBehavior
Type: FP7-PEOPLE-2007-4-1-IOF
Instrument: Marie Curie International Outgoing Fellowships for Career Development (IOF)
Duration: June 2008 - May 2011
Coordinator: INRIA (France)
Others partners: Japanese Advanced Institute for Science and Technology (AIST)
Abstract: The main objective of this research and training project is to enhance the algorithms and control laws of existing humanoid robots in order to obtain a walking behavior versatile and safe enough to be integrated into higher level tasks such as manipulation, vision, tele-operation, interaction with humans, which all require a strong capacity to face unforeseen events in an efficient way. And the objective is to solve this problem with a solution general enough to be applied also to the case of manipulator robots.

8.2. International Initiatives

8.2.1. INRIA Associate Teams

- 2009 -2011: SHARE associated team between INRIA (BiPop and EVASION) and the University of British Columbia (Canada).
8. Partnerships and Cooperations

8.1. International Initiatives

8.1.1. INRIA International Partners

CAD is an INRIA/Tsinghua University team related to LIAMA (China).

8.1.2. Visits of International Scientists

Dr. Fredo Durand (MIT), Pr. J.D. Boissonnat (INRIA) and Pr. Ramanie (Purdue) visited our team this year.

8.1.3. Participation In International Programs

We attend an international program of National Natural Science Foundation of China from 2010 to 2013. Floating Point continuity clearly is a pioneer effort to solving a well-known unsolved problem. Up to now, almost all geometric modeling tool kits are based on traditional mathematics. They ignore the fact that computers can only represent a finite set of real numbers and simply use the formula \((a - \epsilon < b)\) and \((b < a + \epsilon)\) to compare whether two real numbers \(a\) and \(b\) are equal to each other or not. In the way, it becomes a very hard problem how to choose the proper value, i.e., the precision is often out of control in geometric modeling tool kits although few documents report such the fact. This problem is very difficult. We also explore some formal methods and applied them to geometric algorithms. It seems to be an interesting research avenue. Finally, we also plan to study tolerances problem more carefully with CAD/CAM experts, because many of tolerances are not only directly related to the actual manufacturing process.

The central challenge with spline surfaces is to control their continuity when multiple patches join and to enable different types of sharpness. We are especially excited by a new result that addresses a central problem with spline modeling that has been open for five decades: the variation of continuity across a patch. This is needed, for example, when a crease forms in a smooth area. Because spline surfaces are modeled using a (mostly separable) tensorial product of polynomial bases, it is hard to have a different level of continuity on two opposite edges of a patch. We proposed a particularly elegant solution to this challenge by smoothly varying the parametric location of the spline knots. This allows the curve to transition from a configuration where knots overlap (sharp \(C^1\) discontinuity) to a configuration where they are distinct (fully continuous surface). We think that this work will have a large impact on CAD-CAM. Moreover, we speculate that our new geometric representation could be good candidates for better solving numerical simulation (PDEs) problems.
CAGIRE Team

8. Partnerships and Cooperations

8.1. International Initiatives

8.1.1. Visits of International Scientists

- Dr. A. Naïmanova, Institute of Mathematics, Almaty, Kazakhstan came for a one-month stay in September 2011.
7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. CEA Projects

- FR FCM (CNRS Federation on Magnetic Confinement Fusion) project within Euratom-CEA association, Title: "Full wave modeling of lower hybrid current drive in tokamaks" The goal of this project is to develop a full wave method to describe the dynamics of lower hybrid current drive problem in tokamaks.

- FR FCM (CNRS Federation on Magnetic Confinement Fusion) project within Euratom-CEA association, Title: "Numerical Methods for GYSELA", the goal is to help improving the numerical algorithms used by the GYSELA code developed at CEA Cadarache for the simulation of turbulence in magnetic fusion plasmas.

7.1.2. ANR projects

- GYPSI project (2010–2014), https://sites.google.com/site/anrgypsi/: coordinator Philippe Ghendrih (CEA Cadarache), other participants, University of Marseille, Universities of Strasbourg and Nancy (CALVI project-team). The aim is to understand the physics of turbulence in magnetically confined plasma using numerical simulation.

7.1.3. INRIA initiatives


7.2. European Initiatives

7.2.1. Major European Organizations with which you have followed Collaborations

Claus-Dieter Munz: University of Stuttgart, IAG (Germany)
Development of particle in cell methods for the Vlasov-Maxwell equations

7.3. International Initiatives

7.3.1. Participation In International Programs

J. R. Roche participated in the CAPE5-COFECUB binational project with the COPPE-Federal University of Rio de Janeiro and the National Laboratory of Scientific Computing of Brazil.
7. Partnerships and Cooperations

7.1. National Initiatives

We (co-)organized the following seminars:

- Statistical machine learning in Paris – SMILE (Gérard Biau, Gilles Stoltz; see http://sites.google.com/site/smileinparis/);
- Parisian seminar of statistics at IHP (Vincent Rivoirard; see https://sites.google.com/site/semstats).

Grants:

- ANR project in the conception and simulation track: EXPLO/RA (involves Emilien Joly, Sébastien Gerchinovitz, Gilles Stoltz, Jia Yuan Yu; see http://sites.google.com/site/anrexplora/);
- ANR project in the blank program: Parcimonie (involves Sébastien Gerchinovitz, Vincent Rivoirard, Gilles Stoltz; see http://www.proba.jussieu.fr/ANR/Parcimonie/);
- two other ANR blank projects only involve each one member of the team: Banhdits (Vincent Rivoirard), CLARA (Gérard Biau).

7.2. European Initiatives

Thanks to the PASCAL European network of Excellence (http://www.pascal-network.org/), we have strong links with Gábor Lugosi, Universitat Pompeu Fabra, Spain and Nicolò Cesa-Bianchi, Università degli Studi di Milano.

7.3. International Initiatives

We have some internal collaborations, mostly on one-to-one bases, with

- Karine Bertin, University of Valparaiso, Chile;
- Luc Devroye, McGill University, Canada;
- Shie Mannor, Technion, Israel.
8. Partnerships and Cooperations

8.1. Regional Initiatives

We participate to the DIM-Digiteo Alma project. This research project deals with Acute Myelogenous Leukaemia (AML), its mechanisms, controlled by molecular events at the DNA level, and its treatments. See the DISCO team activity report for more details. We are preparing optimal control tools for analyzing the models.

8.2. National Initiatives

Our research activities in Hamilton Jacobi approach for state-constrained control problems is supported by a DGA grant (DGA-ENSTA No 0660037). We are applying our results on reachability analysis and motion planning for collision avoidance for UAVs.

8.3. European Initiatives

8.3.1. FP7 Projet

8.3.1.1. SADCO

Title: Sensitivity Analysis for Deterministic Controller Design
Type: PEOPLE F7
Instrument: Initial Training Network (ITN)
Duration: January 2011 - December 2014
Coordinator: INRIA (France)

See also: http://itn-sadco.inria.fr

Abstract: Optimisation-based control systems concern the determination of control strategies for complex, dynamic systems, to optimise some measures of best performance. It has the potential for application to a wide range of fields, including aerospace, chemical processing, power systems control, transportation systems and resource economics. It is of special relevance today, because optimization provides a natural framework for determining control strategies, which are energy efficient and respect environmental constraints.

The multi-partner initial training network SADCO aims at: Training young researchers and future scientific leaders in the field of control theory with emphasis on two major themes sensitivity of optimal strategies to changes in the optimal control problem specification, and deterministic controller design; Advancing the theory and developing new numerical methods; Conveying fundamental scientific contributions within European industrial sectors.

In order to reach these objectives, SADCO establishes a collaborative research and training network of 11 full partners from both the academic and industrial sectors, and gathers participants with expertises in complementary disciplines in mathematics and engineering. The network also offers a complete range of theoretical, practical and complementary training as well as scientific workshops. SADCO will work together with the young researchers to develop and implement effective training plans tailored to each individual requirements. Multi-disciplinary training based on the integrated scientific programme, secondments, regular meetings, active networking, will ensure the success of this projects.
The development of new ‘clean’ technologies in power, transportation and other domains is a major opportunity for EU industries. The research programme will help place EU universities in the forefront of Optimal Control, a field of mathematics that supports these technologies.

The training programme, based on institutions covering the principal areas of the field, will provide a new generation of young mathematicians with broad skills in Optimal Control, which are not readily acquired at one institution alone. They will be equipped to take forward research in Optimal Control at universities, or to work in related, emerging technological areas, of vital importance to society.

8.4. International Initiatives

8.4.1. Visits of International Scientists

8.4.1.1. Invited professors

- Peter Wolenski, Luisiane State University (4 months, August to November 2011)
- Roberto Ferretti, University of Rome 3 (1 week, August 2011)
- Alejandro Jofre, University of Chile (2 weeks, July 2011)
- Elina Mancinelli, University of Rosario (3 weeks, April 2011)
- Antonio Siconolfi, University of Rome 1 - La Sapienza (2 weeks, May 2011)
- Mohamed Mnif, ENIT Tunis (2 weeks, May 2011)
- Pablo Lotito, University of Rosario (1 week, December 2011)

8.4.1.2. Internships

Soledad Aronna (from Feb 2011 until Dec 2011)
  Subject: Optimal control of systems with singular arcs
  Institution: CONICET (Argentina)

Imène Ben Latifa (from Feb 2011 until Apr 2011)
  Subject: Optimal multiple stopping and valuation of swing options with jumps
  Institution: Ecole Nationale d’Ingénieurs de Tunis (Tunisia)

Eduardo Philip (from Apr 2011 until Jul 2011)
  Subject: Optimal control problems of BV trajectories and with state constraints
  Institution: Universidad Nacional de Rosario (Argentina)

8.4.2. Participation In International Programs

We are setting up a project with Alejandro Jofre (U. Chile, Santiago) in the framework of the CIRIC initiative, on the subject of smart grid optimization.
8. Partnerships and Cooperations

8.1. European Initiatives

We have long-standing the following international collaborations:

- Chalmers University of Technology, Sweden (Prof. Peter Hansbo)
  This collaboration concerns the following subjects: stabilized finite element methods, NXFEM, adaptivity.

- University of Sussex, UK (Prof. Erik Burman)
  This collaboration concerns the following subjects: stabilized finite element methods, NXFEM, adaptivity.

- University of Kiel, Germany (Prof. Malte Braack)
  This collaboration concerns the following subjects: stabilized finite element methods, fluid-acoustic interaction.

8.2. International Initiatives

We have a collaboration with the Institute of Computational Mathematics of the Chinese Academy of Sciences CAS (Prof. Lin Qun, Prof Li Yuan, Dr. Shipeng Mao, Dr. Mingxia Li, Dr. Chunguang Xiong, Qin Li) on finite element methods and numerical fluid mechanics. The team leader has been invited by Prof. Yuan for a one-month during summer 2010 at CAS in Beijing. Dr. Chunguang Xiong is working as a post-doc since june 2011 in the team. Since october 2012 Qin Li is staying as a common doctoral student (supervised by Prof. Lin Qun and the team leader) in the frame of a joint CAS-INRIA program.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Collaboration with Université de Franche Comté
In September 2010, we began a cooperation with Université de Franche-Comté within a COLOR project funded for one year by INRIA-Nancy Grand Est. The main objective of the cooperation is the control of the bilinear Schrödinger equation with unbounded control potentials. The first results have been submitted to international journals \[63\], \[62\] or international conferences \[60\], \[61\] and are currently under review.

8.2. National Initiatives

8.2.1. Administrative responsibilities
- Henrot is the head of Fédération Charles Hermite (FR CNRS 3198) which is a Federation of four scientific units: CRAN (Research Center for Automatic Control), IECN (Institut Elie Cartan of Nancy), LMAM (Mathematical Center of research in Metz), LORIA ((Lorraine Laboratory of IT Research and its Application). He is also head of the “ANR blanc project” GAOS in Nancy.
- Tucsnak
  - Head of the Institut Élie Cartan de Nancy (IECN)
  - Member of the Scientific Council of UHP and at INRIA.
  - Member of the Executive Team and of the Project Committee of the INRIA Nancy-Grand Est Research Centre.
- Alabau is member of CNU, section 26.

8.2.2. National Projects
- CPER (“Contrat Plan Etat Région”):
  - Serres, Sigalotti (leader), Vivalda, Chambrion and Munnier are in “Stabilité et Commande des Systèmes à Commutations”. This is project in the AOC theme, in collaboration with the Automatic Control team at CRAN, is devoted to the stabilization of hybrid systems arising in the domain of DC-DC converters.
  - Scheid, Takahashi (leader) and Tucsnak are in the project “Se propulser dans un fluide, analyse, contrôle et visualisation” (AOC theme), in collaboration with the INRIA team, ALICE.
- Our team is part of the GDR entitled “Fluid-Structure Interactions”.

8.3. European Initiatives
- Henrot is coordinating an application for an International Training Network (ITN - Marie Curie) in the FP7 Program of the European Union. The application involves 11 nodes in 7 European countries.
- Alabau is main coordinator for France of the GDRE CONEDP in Control of PDE between France and Italy.
- Alexandre Munnier, Takéo Takahashi, Marius Tucsnak are in a PHC project PESSOA with a group of IST (Portugal).
• Tucsnak is also involved in a Romanian-French project (Brancusi) with the University of Craiova, on *Controllability of coupled systems*.

8.4. International Initiatives

8.4.1. Projects

Indo-French project (CEFIPRA) with the Tata Institute for Fundamental Research, Bangalore, on *Control of partial differential equations*;

8.4.2. Phd co-supervision

• PhD student Roberto Guglielmi from University Tor Vergata, Roma, Italy is co-supervised by Alabau with, since October 2010.

• PhD student Erica Schwindt is co-supervised by Takahashi and Conca (CMM, university of Santiago of Chile).

• PhD student Imen Ellouze is co-supervised by Vivalda and Mohamed-Ali Hammami from the University of Sfax (Tunisia) (Phd defended in December 2010).

8.4.3. Visits of Foreign researchers

Evans Harrell (Georgia Tech, Atlanta), Gérard Philippin (U. Laval, Québec), Paolo Salani (U. Florence).
8. Partnerships and Cooperations

8.1. Regional Initiatives

Marie Chavent participates to a project financed by the Région Aquitaine for three years (2010-2013), named *PSI : Etude des interactions états psychophysiologiques et musique* including the PHD-grant of Laurent Vezard. The subject of this PHD, co-directed by M. Chavent, F. Faita and P. Legrand from Project-Team ALEA, is *Dimension reduction in the context of supervised learning. Applications to the electrical brain activity study.*

8.2. National Initiatives

8.2.1. ANR FAUTOCOES

The goal of the project "FAUTOCOES" (number ANR-09-SEGI-004) of the ARPEGE program of the French National Agency of Research (ANR) can be described as follows. Today, complex technological processes must maintain an acceptable behavior in the event of random structural perturbations, such as failures or component degradation. Aerospace engineering provides numerous examples of such situations: an aircraft has to pursue its mission even if some gyrosopes are out of order, a space shuttle has to succeed in its re-entry trip with a failed on-board computer. Failed or degraded operating modes are parts of an embedded system history and should therefore be accounted for during the control synthesis.

These few basic examples show that complex systems like embedded systems are inherently vulnerable to failure of components and their reliability has to be improved through fault-tolerant control. Embedded systems require mathematical representations which are in essence dynamic, multi-model and stochastic. This increasing complexity poses a genuine scientific challenge:

- to model explicitly and realistically the dynamical interactions existing between the physical state variables defining the system: pressure, temperature, flow rate, intensity, etc, and the functional and dysfunctional behavior of its components;
- to estimate the performance of the system through the evaluation of reliability indexes such as availability, quality, and safety;
- to optimize the control to prevent system failures, as well as to maintain the system function when a failure has occurred.

Our aim is to meet the previously mentioned challenge by using the framework of piecewise deterministic Markov processes (PDMP’s in short) with an emphasis on probabilistic and deterministic numerical methods. More precisely, our objectives are

- to use the framework of piecewise deterministic Markov processes to model complex physical systems and phenomena;
- to compute expectations of functionals of the process in order to evaluate the performance of the system;
- to develop theoretical and numerical control tools for PDMP’s to optimize the performance and/or to maintain system function when a failure has occurred.


8.2.2. ANR ADAPTEAU

The ANR project ADAPTEAU has been obtained for the period 2012-2016 and will start in january 2012.
ADAPTEAU aims to contribute to the analysis and management of global change impacts and adaptation patterns in River-Estuarine Environments (REEs) by interpreting the scientific challenges associated with climate change in terms of: i) scale mismatches; ii) uncertainty and cognitive biases between social actors; iii) interdisciplinary dialogue on the "adaptation" concept; iv) critical insights on adaptive governance and actions, v) understanding the diversity of professional, social and economic practices vis-à-vis global change. The project aims to build an integrative and interdisciplinary framework involving biophysical and social sciences, as well as stakeholders and civil society partners. The main objective is to identify adaptive strategies able to face the stakes of global change in REEs, on the basis of what we call ‘innovative adaptation options’.

We consider the adaptation of Social-Ecological Systems (SES) through the expected variations of the hydrological regimes (floods / low-flow) of the Garonne-Gironde REE—a salient issue in SW France, yet with a high potential for genericity. The ADAPTEAU project will be organised as follows:

- Achieve and confront socio-economic and environmental assessments of expected CC impacts on the Garonne-Gironde river-estuarine continuum (task 1);
- Identify the emerging ‘innovative adaptation options’ endorsed by various social, economic, political actors of the territory (depolderisation, ‘room for rivers’ strategies, changes in economic activities, agricultural systems or social practices), then test their environmental, economic and social robustness through a selected subset (task 2);
- Scientists, representatives from administrators and civil society collaborate to build adaptation scenarios, and discuss them in pluralistic arenas in order to evaluate their social and economic feasibility, as well as the most appropriate governance modes (task 3).
- Disseminate the adaptation strategies to academics and managers, as well as to the broader society (task 4).

The expected results are the definition and diffusion of new regional-scale reference frameworks for the discussion of adaptation scenarios in REE and other SESs, as well as action guidelines to better address climate change stakes.

THE CQFD team will work on tasks 1 and 3.

### 8.3. International Initiatives

#### 8.3.1. Visits of International Scientists

- Oswaldo Luiz do Valle Costa, Escola Politécnica da USP, Universidade de Sao Paulo, has visited F. Dufour (2 weeks).
- F. Dufour has visited Oswaldo Luiz do Valle Costa, Escola Politécnica da USP, Universidade de Sao Paulo (2 weeks).
- F. Dufour has visited Alexey Piunovskiy, University of Liverpool (2 weeks).
- Alexey Piunovskiy, University of Liverpool, has visited F. Dufour (2 weeks).
- Tomas Prieto-Rumeau, University of Madrid, has visited F. Dufour (2 weeks).
- Richard Stockbridge, University of Wisconsin, Milwaukee, has visited F. Dufour (2 weeks).
- F. Dufour has visited Richard Stockbridge, University of Wisconsin, Milwaukee (2 weeks).
8. Partnerships and Cooperations

8.1. National Actions

- The DeFI group participates to the EADS-X-INRIA Chair: Mathematical Modeling and Numerical Simulation (MMNS): [http://www.cmap.polytechnique.fr/mmnschair/home.html](http://www.cmap.polytechnique.fr/mmnschair/home.html) created on 2008 for at least 4 years and with a total budget of 1 million euros. G. Allaire is the leader of this Chair.
- G. Allaire participates to the GDR MOMAS

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7

Program: PHC PROCOPE
Project acronym: ISTD
Project title: Inverse scattering in the time domain
Duration: 09/2010 - 09/2012
Coordinator: A. Lechleiter
Other partners: University of Goettingen, Department of Math. (Germany)
Abstract: Develop MuSiC type algorithm for inverse scattering problems in time domain.

8.2.2. Major European Organizations with which you have followed Collaborations

Partner 1: University of Goettingen, Department of Math. (Germany)
Development of conformal mapping method to electrostatic inverse problems. Correspondant: Rainer Kress.

Partner 2: University of Genova, Department of Math. (Italy)

8.3. International Initiatives

8.3.1. INRIA Associate Teams

8.3.1.1. ISIP

Title: Inverse Scattering and Identification Problems
INRIA principal investigator: Houssem HADDAR
International Partner:
Institution: University of Delaware (United States)
Laboratory: Mathematical Department

Duration: 2008 - 2013
See also: [http://www.cmap.polytechnique.fr/~defi/ISIP/isip.html](http://www.cmap.polytechnique.fr/~defi/ISIP/isip.html)
The associated team concentrates on the use of qualitative methods in electromagnetic inverse scattering theory with applications to the imaging of urban infrastructure, the nondestructive evaluation of coated materials and medical imaging. Most of the effort is focused in the solution of the inverse problems using time harmonic waves, in particular for frequencies in the resonance regime.

8.3.2. Visits of International Scientists

Prof. F. Cakoni (University of Delaware, USA) visited the DEFI team from September 15th till December 15th 2011 during her sabbatical semester. Her stay was supported by CNRS and the associated team ISIP.

Prof. D. Colton (University of Delaware, USA) visited the DEFI team one week in June and one week in November 2011. His stay was supported by the ISIP associated team.

Dr. Fahmi Ben Hassen (LAMSIN, Tunisia) visited the DEFI team two weeks in March 2011.

Dr. Givanni Giorgi (University of Genova, Italy) visited the DEFI team during three months (February-April) in 2011.

Dr. Ozgur Ozdemir (Istanbul Technical University, Turkey) visited the DEFI team two weeks in August 2011.
8. Partnerships and Cooperations

8.1. Regional Initiatives

+ DIGITEO Project (DIM LSC) ALMA
  Project title: Mathematical Analysis of Acute Myeloid Leukemia
  December 2010 - December 2013
  Coordinator: Catherine Bonnet
  Other partners: Inria Paris-Rocquencourt, France, L2S, France, INSERM, Cordeliers Research Center, France.
  Abstract: this project studies a model of leukaemia based on previous works by M. Adimy and F. Crauste (Lyon), with theoretical model design adjustments and analysis in J. L. Avila Alonso’s Ph D thesis and experimental parameter identification initiated by F. Merhi, postdoc of Bang (Dec. 2010-Nov. 2011), working at St. Antoine Hospital (Paris) on biological experiments on leukaemic cells.

+ DIGITEO Project (DIM Cancéropôle) ALMA2
  Project title: Mathematical Analysis of Acute Myeloid Leukemia - 2
  October 2011 - March 2013
  Coordinator: Jean Clairambault (Inria Paris-Rocquencourt)
  Other partners: Inria Saclay-Île-de-France, France, L2S, France, INSERM, Cordeliers Research Center, France.
  Abstract: This project has taken over the experimental identification part in St. Antoine Hospital, together with further model design with the postdoc of A. Ballesta (BANG). With this postdoc project will also be developed the theoretical and experimental - in leukaemic cell cultures - study of combined therapies by classical cytotoxics (anthracyclins, aracytin) and recently available targeted therapies (anti-Flt-3).

+ DIGITEO Project (DIM LSC) MOISYR
  Project title: Monotonie, observateurs par intervalles, et systèmes à retard
  December 2011 - December 2014
  Coordinator: Frédéric Mazenc
  Other partners: organisme, labo (pays) L2S, France, Mines-ParisTech, France.
  Abstract: MOISYR is concerned with the creation of the problem of extending the theory of monotone systems to the main families of continuous time systems with delay along with the application of this theory to the design of observers and interval observers. In particular, nonlinear systems with pointwise and distributed delays and stabilizable systems with delay in the input shall be considered. In a second step, we shall extend our result to discrete time systems and to a specific class of continuous/discrete systems called Networked Control Systems.

8.2. National Initiatives

+ A. Quadrat has a long term collaboration with T. Cluzeau and M. Barkatou (University of Limoges, XLIM).
8.3. European Initiatives

8.3.1. Major European Organizations with which Disco has followed Collaborations

A. Quadrat has developed a strong collaboration with the members of the Lehrstuhl B für Mathematik and particularly with Daniel Robertz and Mohamed Barakat. He is a member of a PHC Procope developed in collaboration with the University of Limoges (XLIM) and the Lehrstuhl B für Mathematik, RWTH Aachen University (2011-2012) which aims at developing computer algebra aspects to mathematical systems theory and control theory.

C. Bonnet has developed a long term collaboration with J.R. Partington, Department of Pure Mathematics of the University of Leeds on the robust control of distributed parameter systems.

C. Bonnet and S.I. Niculescu have started a collaboration with H. Özbay, Bilkent University some years ago on various subjects including stability analysis of linear and nonlinear delay systems.

8.4. International Initiatives

8.4.1. INRIA International Partners

- C. Bonnet has started a collaboration with Unicamp, Sao Paulo Brazil and a collaboration with University of Kyoto, Japan.
- F. Mazenc has a strong collaboration with M. Malisoff, Louisiana State University, USA.

8.4.2. Visits of International Scientists

1. Corina Constantinescu, University of Lausanne, Switzerland, 5–9 July 2011.
2. André Fioravanti, Unicamp, Sao Paulo, Brazil, 22 November - 5 December 2011.
4. Hitay Özbay, Bilkent University, Turkey, 14-18 November 2011.
5. Stefan Müller, Radon Institute for Computational and Applied Mathematics (RICAM), Linz, Austria, 2–9 June 2011.
6. Daniel Robertz, RWTH Aachen University, 3–8 October, (PHC Procope).

8.4.2.1. Internship

8. Partnerships and Cooperations

8.1. Regional Initiatives

+ PPF (Bioinformatics): This national program within the university of Lille (USTL) deals with solving bioinformatics and computational biology problems using combinatorial optimization techniques, 2006-2009; 2010-2013.
+ CIA (Campus Intelligence Ambiante) project from CPER (Contrat Plan Etat Région): Transversal research action: “High performance computing”, 2010-2013.

8.2. National Initiatives

+ ANR GAZE & EEG (Programme Blanc NT09_511856). Coordinator: A. Guérin-Dugué (University of Grenoble), 2009-2011.
+ GdR-RO project (CNRS) "Set-based Search for Multiobjective Combinatorial Optimization", involving the University of Angers (France), 2011

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: COST
Project acronym: IC0804
Project title: Energy efficiency in large scale distributed systems
Duration: Jan 2009 - May 2013
Coordinator: J. M. Pierson
Other partners: More than 20 European countries.
Abstract: The COST Action IC0804 proposes realistic energy-efficient alternate solutions to share IT distributed resources. As large scale distributed systems gather and share more and more computing nodes and Storage resources, their energy consumption is exponentially increasing. While much effort is nowadays put into hardware specific solutions to lower energy consumptions, the need for a complementary approach is necessary at the distributed system level, i.e. middleware, network and applications. The Action characterizes the energy consumption and energy efficiencies of distributed applications.

8.3.2. Major European Organizations with which you have followed Collaborations

University of Luxembourg: CSC, ILIAS (Luxembourg)
Design of parallel and hybrid metaheuristics to solve complex optimization problems

University of Malaga: ETSI Informatica (Spain)
Parallel metaheuristics for dynamic optimization
8.4. International Initiatives

8.4.1. INRIA Associate Teams

8.4.1.1. MOMDI

Title: Dynamic and multi-criteria combinatorial optimization on Grid computing systems
INRIA principal investigator: Talbi El Ghazali
International Partner:
  Institution: University of Malaga (Spain)
  Laboratory: E.T.S.I Informatica
Duration: 2009 - 2011
See also: http://dolphin.lille.inria.fr/Dolphin/EA-DOLPHIN

8.4.2. International Cooperation

- University of Sydney, Australia
- University of Montreal, Canada
- Ecole Polytechnique of Montreal, Canada

8.4.3. Visits of International Scientists

The project had visitors during the year 2010:
- Prof. Khaled Mellouli, University of Tunis
- Prof. Theodore Crainic, University of Montreal
- Prof. Pascal Bouvry, University of Luxembourg

8.4.4. Participation In International Programs

- INRIA project 3+3 Méditerranée PERFORM (2006-2012) involving the University of Malaga (Spain), University of Constantine (Algeria), and University of Tunis (Tunisia). This project deals with multi-objective optimization.
- Project FCT MST4IROT: New models and solution techniques for integrated and real-time optimization in the supply chains (Project in Portugal, coordinator Claudio Alves). Participants: Universities of Minho (PT), Valenciennes, Compiègne, Lille and Brunel (UK) : Real-Time Optimization in Supply-Chain.
- INRIA STIC-Tunisie 2011-2012.
5. Partnerships and Cooperations

5.1. Regional Initiatives

- Contrats de Projet Etat-Région Champagne-Ardennes CPER " BRAMMS : Buste-Reconstruction 3D, Acquisition de la morphologie, Modélisation et Simulation du comportement au porter" Mise au point d’une méthode d’acquisition de la morphologie du buste féminin, développement d’algorithmes de reconstruction de surface 3D d’un buste féminin à partir de photos numériques dans l’objectif de modéliser le comportement du sein en modes statiques et dynamiques

5.2. National Initiatives

- Projet ANR-2011-NANO-008: NANOMORPH: "Nanomorphologie des nanotubes/fils en suspension liquide"
  
  **Participants**: Thomas Grosjes [correspondant], Dominique Barchiesi
  
  Le projet NANOMORPH a pour objet principal le développement et la mise au point d’une d’une instrumentation optique pour déterminer, la distribution en tailles et le coefficient de forme de suspensions de nanofils (NF) ou de nanotubes (NT) en écoulé. Au cours de ce projet, deux types de techniques optiques complémentaires seront développées. La première, basée sur la diffusion statique de la lumière, nécessite d’étudier au préalable la physico-chimie de la dispersion, la stabilisation et l’orientation des nanofils dans les milieux d’étude. La seconde méthode, basée sur une méthode opto-photothermique pulsée, nécessite en sus, la modélisation de l’interaction laser/nanofils, ainsi que des phénomènes multiphysiques induits par ce processus. L’implication de l’équipe-projet GAMMA3 concerne principalement la simulation multiphysique de l’interaction laser-nanofils et l’évolution temporelle des bulles et leurs formations. L’une des principales difficultés de ces problématiques est que la géométrie du domaine est variable (à la fois au sens géométrique et topologique). Ces simulations ne peuvent donc être réalisées que dans un schéma adaptatif de calcul nécessitant le remaillage tridimensionnel mobile, déformable avec topologie variable du domaine (formation et évolution des bulles).

- Distène ILab.

5.3. Partnerships and cooperations

- Université de Technologie de Troyes, maillages pour des problèmes de mécanique du solide et d’électromagnétisme.
- CEA Le Ripault, maillages multidomaines déformables, logiciel BL2D-ABAQ.
- BRGM (Orléans),
- CEREGE (Aix-en-Provence),
- CORIA (Rouen),
- IUSTI (Marseille),
- UCL (Louvain-la-Neuve, Belgique),
- SPBAT(Paris XIII),
- Centro de Fisica de Materiales (CSIC) - Spain
- INSERM U698 - France,
- University of Heidelberg - Germany,
5.4. European Initiatives

- Projet Européen : FP7 - Health-F5-2009-241818 : NANOANTENNA

**Participants:** Dominique Barchiesi [correspondant], Thomas Grosge, Sameh Kensentini

Développement d’un biocapteur in vitro, ultra sensible et sélectif destiné à la détection de protéines impliquées dans les premières phases du développement de maladies. Modélisation et optimisation numériques du dispositif (taille, forme, couplage électromagnétique-matériaux).

5.5. International Initiatives

5.5.1. Visits of International Scientists

- D. Marcum: Mississippi State University, USA, June-July 2011

5.6. Internship

- Nicolas Barral : Improvement of the numerical convergence of MEV numerical scheme and study CFL lax for implicit time integration algorithm.
- Yossel Hollocou: Partitionnement de surfaces triangulées.
6. Partnerships and Cooperations

6.1. Regional Initiatives

- **Digitéo project CONGEO.** CONGEO (2009–2013) is financed by Digitéo in the framework of the DIM Logiciels et systèmes complexes. It focuses on the neurophysiology applications. U. Boscain, Y. Chitour (leader), F. Jean and P. Mason are part of the project.

6.2. National Initiatives

- **ANR project GCM.** The project ANR GCM (*programme blanc*, 2009–13) involves the great majority of GECO’s members (permanent and external). It focuses on various theoretical aspects of geometric control and on quantum control. It is coordinated by J.-P. Gauthier.

- **ANR ArHyCo.** The project ANR ArHyCo (*programme ARPEGE*, 2009–13) is about switched systems. It is coordinated by J. Daafouz. The first theme of the ANR, on stability of switched systems, is lead by M. Sigalotti.

6.3. European Initiatives

6.3.1. Collaborations in European Programs

Program: ERC Starting Grant
Project acronym: GeCoMethods
Project title: Geometric Control Methods for the Heat and Schroedinger Equations
Duration: 1/5/2010 - 1/5/2015
Coordinator: Ugo Boscain

Abstract: The aim of this project is to study certain PDEs for which geometric control techniques open new horizons. More precisely we plan to exploit the relation between the sub-Riemannian distance and the properties of the kernel of the corresponding hypoelliptic heat equation and to study controllability properties of the Schroedinger equation.

All subjects studied in this project are applications-driven: the problem of controllability of the Schroedinger equation has direct applications in Laser spectroscopy and in Nuclear Magnetic Resonance; the problem of nonisotropic diffusion has applications in cognitive neuroscience (in particular for models of human vision).

Participants. Main collaborator: Mario Sigalotti. Other members of the team: Andrei Agrachev, Riccardo Adami, Thomas Chambrion, Grégoire Charlot, Yacine Chitour, Jean-Paul Gauthier, Frédéric Jean.

6.3.2. Major European Organizations with which you have followed Collaborations

SISSA (Scuola Internazionale Superiore di Studi Avanzati), Trieste, Italy.

We collaborate with the Geometric Control group at SISSA mainly on subjects related with sub-Riemannian geometry. Thanks partly to our collaboration, SISSA has established an official research partnership with École Polytechnique.

6.4. International Initiatives

6.4.1. Visits of International Scientists

Remco Duits, Eindhoven University of Technology. June 2011
6.4.2. Participation In International Programs

- Laboratoire Euro Maghrébin de Mathématiques et de leurs Interactions (LEM2I)
  http://www.lem2i.cnrs.fr/

- GDRE Control of Partial Differential Equations (CONEDP)
  http://www.ceremade.dauphine.fr/~glass/GDRE/
7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. Collaborations in European Programs, except FP7

Program: Support to Science Element, ESRIN/AO/1-6668/11/I-AM, Fund: E/0029-01-L
Project acronym: Oceanflux
Project title: Oceanflux
Duration: November 2011 - May 2013
Coordinator: Dr. Christoph S. Garbe, Interdisciplinary Center for Scientific Computing (IWR), University of Heidelberg.
Other partners: INRIA, GEOSTAT (FRANCE); KIT, IKM-ASF (Allemagne); CNRS, LEGOS (France); IRD (France); Université Paul Sabatier, (France).
Abstract: Mapping at high spatial resolution of GHGs exchange flux between ocean and atmosphere using model outputs and nonlinear techniques in signal processing.

Program: PHC
Project acronym: Volubilis
Project title: Study of upwelling in the Moroccan coast by satellite imaging
Duration: November 2010 - October 2013
Coordinator: K. Daoudi, INRIA, GEOSTAT (France)
Other partners: Rabat University, CRTS.
Abstract: Multiscale methods for the characterization of coastal upwelling from remote sensing data.

Program: OSTST CNES-NASA
Project acronym: Hiressubcolor
Project title: Multiscale methods for the evaluation of high resolution ocean surface velocities and subsurface dynamics from ocean color, sst and altimetry
Duration: November 2008 - December 2011
Coordinator: H. Yahia, INRIA, GEOSTAT (France)
Other partners: CNRS LEGOS (France), ICM-CSIC (Spain), LOCEAN (France)
Abstract: nonlinear signal processing methods for high resolution mapping of ocean dynamics.

7.2. National Initiatives

- Region Aquitaine research call. Funding of the OPTAD project on adaptive optics.
- Region Aquitaine research call. Funding for equipment in Speech databases and software.
- GEOSTAT is funded by Conseil Région Aquitaine for acquiring Speech databases and software.
- Marie-Curie post doctoral grant with Conseil Région Aquitaine on heartbeat dynamics.
- ARC FIBAUR with INRIA, ESPCI and (INSERM EA 2668 Electrophysiology and Cardiac Stimulation).
7.3. International Initiatives

7.3.1. Internship

Joshua Winebarger (from Apr 2011 until Sep 2011)

Subject: Fusion of different speech segmentation algorithms
Institution: Georgia Tech. (United States)

7.3.2. Participation In International Programs

Program: Canadian CRSNG
Project acronym: Profilage à partir des données hétérogènes du Web pour la cybersécurité
Project title: Profilage à partir des données hétérogènes du Web pour la cybersécurité
Duration: March 2011 - February 2014
Coordinator: Concordia University
Other partners: University of Sherbrooke, E-Profile Company, S. d. Quebec, GEOSTAT (INRIA)
Abstract: Use of various complex signals for cybersecurity.
I4S Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Pôle de Compétitivité ASTECH MODIPRO

Participants: Laurent Mevel, Meriem Zghal.

Contract INRIA 4162

I4S is implied in a national project for aircraft SHM starting Fall 2009. This project will improve on monitoring procedures developed in previous projects to provide some algorithms for use in Dassault Aviation aircraft monitoring procedures. I4S works together with Qinghua Zhang of INRIA Rocquencourt, project team SISYPHE, on this topic.

8.1.2. Collaboration with IFSTTAR

Participant: Laurent Mevel.

I4S is related to the forthcoming project FUI SIPRIS (Systèmes d’Instrumentation pour la prévention des risques), lead by Advitam.

8.1.3. Collaboration with ALEA, EPI Team at Inria Bordeaux Center

Participants: Laurent Mevel, Meriem Zghal.

I4S has started a 2 year collaboration with EPI ALEA on using particular filtering in vibration analysis. A new engineer has been hired for that task, starting October 2010.

8.1.4. Collaboration with ISAE

Participants: Laurent Mevel, Ahmed Jhinaoui.

A new PhD student, Ahmed Jhinaoui has started a new thesis on helicopter instability. This thesis is codirected by professor Morlier from ISAE, France. This thesis is funded by FP7-NMP Large Scale Integrated Project IRIS.

8.2. European Initiatives

8.2.1. FP7 ISMS

Type: PEOPLE

Instrument: Industry-Academia Partnerships and Pathway (IAPP)

Duration: September 2010 - August 2013

Coordinator: SVS (Structural Vibrations Solutions) (Denmark)

Others partners: University of British Columbia, Canada

In 2009, a proposal has been submitted with SVS, University of British Columbia and I4S to develop a framework for handling structural health monitoring methods. This proposal implies some long stay of the concerned people, Laurent Mevel and Michael Döhler for I4S abroad. Palle Andersen and one of its engineer from SVS are assumed to stay 9 months at INRIA, for tighten integration of COSMAD and ARTEMIS software. The proposal has been rated 88/100 and ranked A in the final selection procedure. The project has been signed on August 1st 2010 and has been running from September 1st. Michael Döhler is spending 5 months in 2010-2011 in Danemark.
8.2.2. FP7-NMP CP-IP 213968-2 IRIS

Type: Cooperation
Instrument: Collaborative project -Large Scale Integrating project
Duration: October 2008 - March 2012
Coordinator: VCE, Austria (Denmark)
Others partners: 40 partners

IRIS (Integrated European Industrial Risk Reduction System), which helds its kick off meeting in October 2008. This project has been elaborated within the framework of the SAMCO association. I4S is involved in the online monitoring sub-project.

I4S is involved in the core consortium of this FP7-NMP Large Scale Integrated Project.

INRIA is involved in Group 3 about Structural Health Monitoring. I4S works with Sheffield University and BAM (Germany) for development of tools for structural damage detection for bridges and wind farms. Laurent Mevel is also member of the core IRIS Vision group, and is responsible of the scientific coherency of the project.

8.3. International Initiatives

8.3.1. INRIA International Partners

8.3.1.1. SIMS, Canada
Participants: Michael Döhler, Laurent Mevel.

A new project called SIMS is currently ongoing on vibration analysis and monitoring in Canada. This project is funded by Ministry of Transport, British Columbia, Canada. It implies deep collaboration with University of British Columbia, Canada. This project has connexions with partners of IRIS project, including University of Tokyo, Japan.

8.3.1.2. Collaboration on damage localization and monitoring with Boston University
Participants: Michael Döhler, Laurent Mevel, Luciano Marin.

This collaboration involves a new PhD student, Luciano Marin, and is involving Professor Bernal from University of Boston, USA. Professor Bernal visited us for one week in 2010.

8.3.2. Visits of International Scientists

D. Bernal of Northeastern University, Boston visited us in October 2011.
H. Vollesen was 6 months in 2011 in I4S during the ISMS project.
7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR Programme blanc (BLAN) MEGAS: 2009-2012

**Participants:** François Castella, Philippe Chartier, Arnaud Debussche, Erwan Faou.

Geometric methods and sampling: application to molecular simulation. The project is financed for 3 years, coordinated by Tony Lelièvre and gathers the following teams and persons:

- Team of Eric Cancès at CERMICS
- Team IPSO
- Mathias Rousset from INRIA Lille
- Christophe Chipot, from the CNRS in Nancy.

P. Chartier is the coordinator for IPSO.

7.1.2. ANR GYPSI (leader P. Beyer)

**Participant:** Nicolas Crouseilles.

The full description is available at [https://sites.google.com/site/anrgypsi/](https://sites.google.com/site/anrgypsi/)

7.1.3. INRIA Large scale initiative FUSION

**Participant:** Nicolas Crouseilles.

Leader E. Sonnendrücker. The full description is available at [http://www.math.u-strasbg.fr/ae_fusion](http://www.math.u-strasbg.fr/ae_fusion)

7.2. European Initiatives

7.2.1. FP7 Projet

7.2.1.1. Geopardi

**Title:** Geometric Partial Differential Equations  
**Instrument:** ERC Starting Grant (Starting)  
**Duration:** September 2011 - August 2016  
**Coordinator:** INRIA (France)

See also: [http://www.irisa.fr/ipso/perso/faou/geopardi.html](http://www.irisa.fr/ipso/perso/faou/geopardi.html)

**Abstract:** The goal is to develop new numerical methods for the approximation of evolution equations possessing strong geometric properties such as Hamiltonian systems or stochastic differential equations. Use intensive numerical simulations to discover and analyze new nonlinear phenomena.

7.3. International Initiatives
7. Partnerships and Cooperations

7.1. Regional Initiatives
- Pôle Finance Innovation.
  Project “Credinext” on credit risk derivatives (2009-2012).

7.2. National Initiatives
  Partners ENST, ENPC, University Paris-Dauphine.

7.3. European Initiatives
7.3.1. Collaborations in European Programs, except FP7
  Eurostars Program “Transparency in Financial Markets” (OSEO grant).

7.4. International Initiatives
7.4.1. Conferences, Seminars, Invitations
7.4.1.1. Conferences
   • A. Alfonsi:
   • V. Bally:
     2. Stochastic analysis, Levy processes and BSDE’s, University of Innsbruck, Austria, October 3-7, 2011. “Regularization properties for the 2D homogeneous Boltzman equation without cutoff”.
4. International Conference on Malliavin Calculus and Stochastic Analysis in Honor of Professor David Nualart. March 19-21, 2011, Kansas University, USA. “Regularization properties for the 2D homogeneous Boltzmann equation without cutoff”.

- B. Jourdain:
  2. Seventh Seminar on Stochastic Analysis, Random Fields and Applications, Ascona, 23-27 May, High order discretization schemes for stochastic volatility models

- J. Hosking:

- A. Sulem:
  3. Stochastic Analysis Conference in Ascona, Suisse, Mai 2011

7.4.1.2. Seminars

- A. Alfonsi:
  - "Exact and High order discretization schemes for Wishart processes and their affine extensions", (April at Evry, May at Mannheim).

- B. Jourdain
  - Applied mathematics seminar of the collège de France, 18 March, Robust variance reduction techniques for Gaussian random vectors
  - Probability theory, Statistics and control seminar at ENSTA, 6 April, Adaptive variance reduction for Gaussian random vectors
  - Mathematical Finance, Numerical probability and Statistics of random processes working group Paris 6, 20 October, Exercise boundary of the American put option in the Black-Scholes model with discrete dividends

- C. Labart:
  - Seminar at Institut Fourier, May 2011.

- J. Lelong:
  - Seminar of the University of Montpellier II (Institut de mathématiques et de modélisation de Montpellier)

- A. Sulem:
  - ENSTA Seminar, April 2011.

7.4.1.3. Invitations

A. Alfonsi: University Mannheim, by Alexander Schied (23rd to the 25th of May)

7.4.2. Visits of International Scientists

7.4.2.1. Invited Professors

Lucia Caramellino (University Tor Vergata, Rome); A. Kohatsu Higa (University of Osaka); A. Schied (Mannheim University).
7.4.2.2. Internship

- Phuong Nguyen [Ecole Polytechnique, 3rd year]. Supervisor: A. Sulem and S. Ould Aly; Subject: European Option Pricing in a stochastic volatility model
- Nicolas Baby [ENSTA, 2nd year]. Supervisor: C. Labart on “Numerical methods for solving BSDEs” (2 months).
8. Partnerships and Cooperations

8.1. Actions nationales/National Initiatives

- Projet DIGITEO PASO (Preuve, Analyse Statique, Optimisation), de Sept. 2008 à Avril. 2011. Ce projet, dont le but est notamment d’appliquer des techniques d’optimisation à des problèmes de preuve de propriétés numériques de programmes, est coordonné par S. Putot (équipe MeASI, LIX/CEA), il fédère en outre des chercheurs de l’équipe-projet Typical (B. Werner), du LSS de Supélec (M. Kieffer, E. Walter), et de Maxplus (S. Gaubert).

- Projet ANR Arpège ASOPT (Analyse statique et Optimisation), responsable B. Jeannet. Partenaires: équipe-projet Popart (INRIA Grenoble), équipe MeASI, EADS, et Maxplus. Ce projet a été labellisé par le pôle de compétitivité System@tic. Ce projet a financé notamment le postdoc de S. Sergeev dans l’équipe.

- Participation au projet ANR CPP (Confidence, Proof and Probabilities), responsable J. Goubault Larecq. Partenaires: LSV, CEA List, INRIA Saclay (Comète [responsable], Parsifal, Maxplus), Supelec L2S, Supelec SSE.

8.2. Actions internationales/International Initiatives

- La thèse de Pascal Benchimol est financée par une bourse Monge/DGA prévoyant des visites régulières du doctorant dans l’équipe de Michael Joswig (TU-Darmstadt).

- La thèse de Zheng Qu est co-encadrée par Shanjian Tang de l’université Fudan (Shanghai), dans l’équipe duquel la doctorante effectue une partie de son travail de recherche.


8.3. Accueils de chercheurs étrangers/Exterior research visitors

- William McEneaney (Université de San Diego, USA), 4 jours. en mars
- Rajendra Bhatia (Indian Statistical Institute, New Delhi, Inde), 1 semaine en mars.
- T.E.S. Raghavan (Université de l’Illinois à Chicago, USA), 2 jours en juin.
- Alexander Guterman (Université d’état de Moscou), 5 jours en juillet.
- Ricardo Katz (Conicet, Rosario, Argentine), 1 mois en juillet.
- Weixu Su (Department of Mathematics, Fudan University, Shanghai, China and Université de Strasbourg and CNRS), 3 jours en juillet.
- Jimmie Lawson (Louisiana State University, USA), 1 semaine en novembre.
8. Partnerships and Cooperations

8.1. Regional Initiatives

Angelo Iollo is belongs to the Aerospace Valley committee IGPC. He is monitoring the project ECOSEA for the fnrae.

8.2. Regional Initiatives

Participants: Thierry Colin, Mathieu Colin.

We obtained a grant of the Aquitaine district jointly with our partner Rhodia for the years 2007-2010 concerning the modelling and computation of non-newtonien flows in micro-channel in order to study enhance oil recovery.

8.2.1. Grant with the Aquitaine District.


It is a joint grant with Rhodia-LOF that enables us to buy a cluster of 200 processors.

8.3. National Initiatives

8.3.1. ANR MANIPHYC

Participants: Charles-Henri Bruneau, Thierry Colin.


8.3.2. ANR CARPEINTER

Participants: Héloïse Beaugendre, Michel Bergmann, Charles-Henri Bruneau, Angelo Iollo [Leader Project], Lisl Weynans.

The P.I. is Angelo Iollo. See http://www.math.u-bordeaux1.fr/CARPEINTER/

8.3.3. ANR CYCLOBULLE

Participants: Charles-Henri Bruneau, Yong Liang Xiang.

The formation and dynamics of long lived coherent structures in atmospheric flows can be mimicked by soap film experiments on an hemisphere heated at the equator. The aim of this work is to simulate such flows and to compare both to the experiments and to the known data of various tornados.

8.3.4. ANR INTCELL

Participants: Thierry Colin, Olivier Saut, Clair Poignard.

The members T.Colin, C.Poignard and O.Saut are involved in the consortium INTCELL directed by P.LEVEQUE (XLIM), and which begun in December 2010. This mutlidisciplinary project, composed of four partners (XLIM laboratory, Vectorology and Anticancer therapies team at the IGR, EDAM and MC2) aims at studying the electropmeabilization by nanopulses at the subcellular level. The goal is to develop new electrical devices and accurate models to understand the electropmeabilization of the cytoplasm constituents such as the nuclear envelop or the mitochonrdial membrane, based on the experiments and on the simulations of molecular dynamics.
8.3.5. ANR MEMOVE

Participants: Mathieu Colin, Thievery Colin, Angelo Iollo, Clair Poignard, Olivier Saut, Lisl Weynans.

Part of the team (M.Colin, T.Colin, A.Iollo, C.Poignard, O.Saut and L. Weynans) are involved in the consortium MEMOVE coordinated by MC2 (coordinator C. Poignard), and which begins at the beginning of 2012. This consortium is composed of four partners (the Vectorology and Anticancer therapies team at the IGR, the bioengineering laboratory AMPERE of Lyon and the Department of mathematics of Versailles). It aims at developing electroporation models from the cell scale to the tissue scale. This project focuses on quite long pulses (from micro- to milli-pulses) compared with the ANR consortium INTCELL that has begun in december 2010. The main goal is to provide multi-scale modelling of "classical" eletroporation, in order to obtain numerical tools that can help from one side the biologists to understand the electroporation process when "non standard" pulses are applied, and from the other side it eventually aims at providing tools for the physicians to optimize the pulse delivering when the electrochemotherapy is used.

8.4. European Initiatives

8.4.1. FP7 Projet

8.4.1.1. FFAST

Title: ___FUTURE FAST AEROELASTIC SIMULATION TECHNOLOGIES___

Type: COOPERATION (TRANSPORTS)

Instrument: Specific Targeted Research Project (STREP)

Duration: October 2010 - December 2012

Coordinator: University of Bristol

Others partners: ___University of Bristol, iris, TU Delft, Politecnico di Milano, Numeca, EADS, DLR, Airbus, University of Cap Town, csir, Optimad___

See also: ___http://www.bris.ac.uk/aerodynamics-research/ffast/___

Abstract: ___The FFAST project aims to develop, implement and assess simulation technologies to accelerate future aircraft design. These technologies will demonstrate a step change in the efficiency and accuracy of the dynamic aeroelastic "loads process" using unique critical load identification methods and reduced order modelling. The outcome from the project will contribute to the industrial need to reduce the number of dynamic loads cases analysed, whilst increasing the accuracy and reducing the cost/time for each unsteady aeroelastic analysis performed compared to the current approach.

Unsteady loads calculations play an important part across much of the design and development of an aircraft, and have an impact upon the concept and detailed structural design, aerodynamic characteristics, weight, flight control system design, control surface design, performance, etc. They determine the most extreme stress levels and estimate fatigue damage and damage tolerance for a particular design. For this purpose, loads cases due to dynamic gusts and manoeuvres are applied to detailed structural models during the design phase.

The flight conditions and manoeuvres, which provide the largest aircraft loads, are not known a priori. Therefore the aerodynamic and inertial forces are calculated at a large number of conditions to give an estimate of the maximum loads, and hence stresses, that the structure of the detailed aircraft design will experience in service. Furthermore these analyses have to be repeated every time that there is an update in the aircraft structure. Within the modern civil airframe industry, each of these loads calculation cycles requires more than 6 weeks. This long lead time, together with the multiple times this calculation procedure needs to take place, has a detrimental effect on cost and time to market. ___
This discussion of the number of critical loads cases raises two main points. First, the replacement of the current low fidelity models with more accurate aeroelastic simulations is attractive because of the reduced tunnel testing costs and the decreased risk of design modification in the later design phases, however the overall computational costs of the loads process must not increase. Secondly, the new aircraft configurations that will be vital to meet 2020 performance targets are likely to possess design envelope boundaries and therefore critical loads cases that are very different from those previously found on conventional aircraft. Engineering experience, that is currently used to reduce the number of critical loads cases without compromising air safety, cannot be extended to novel configurations.

8.5. International Initiatives

Collaboration with Hassan Fathallah, Neuro-oncoly and mathematics, University of Alabama at Birmingham. We work on numerical modeling of brain tumor.

Collaborations with Luca Zannetti, Politecnico di Torino; Simone Camarri, Universita di Pisa; Eyal Arian, Boeing Commercial Airplanes.

8.5.1. Visits of International Scientists

- visit of M. Ohta from Saitama University (March 2010-March 2011).
- visit of R. Mittal from Johns Hopkins University, Baltimore, USA (June-July 2011).

8.6. Visitors

- visit of M. Ohta from Saitama University (March 2010-March 2011).
- visit of R. Mittal from Johns Hopkins University, Baltimore, USA (June-July 2011).
7. Partnerships and Cooperations

7.1. Regional activities

The project-team is shared between INRIA and Ecole des Ponts ParisTech.

7.2. National Initiatives

The project-team is involved in several ANR projects:

- the ANR MANIF has been accepted in June 2011. It focuses on the mathematical and numerical analysis of electronic structure models, such as, in particular, the Kohn-Sham model. It includes two research teams: researchers from the JL Lions Laboratory (Paris 6) and the Micmac team. It is coordinated by Eric Cancès.

- F. Legoll, T. Lelièvre and G. Stoltz participate to the ANR MEGAS. Its aims are to study several methods for numerical simulation, with an emphasis on sampling methods. It includes four research teams: the INRIA project IPSO in Rennes, the INRIA project SIMPAF in Lille, the eDAM team in Nancy (chemistry), and our team. The scientist in charge is Tony Lelièvre.

- T. Lelièvre and G. Stoltz participate to the ANR Big MC, which is focused on the study of Monte-Carlo methods for high-dimensional problems, with typical applications in financial mathematics, Bayesian statistics, and computational statistical physics. Three nodes participate to this project: one research team at the Institut TELECOM, another one at CEREMADE, University Paris Dauphine, and the third one at University Paris Est (including two members of our team). The coordinator is Gersende Fort (TELECOM).

- C. Le Bris participates to the ANR EMAQS. The scientist in charge is Karine Beauchard (CMLS, Ecole polytechnique).


- I. Dabo participates to the ANR CriMin (Crystal-chemistry of iron-bearing minerals and implications in the geochemical cycling of metal pollutants). This ANR is coordinated by M. Blanchard, Institut de Minéralogie de Physique des Milieux Condensés, Université Paris 6.

In addition, the team is participating in

- the GdR Quantum dynamics. This interdisciplinary research network is focused on physical and mathematical problems related to the time evolution of quantum systems (transport problems, nonequilibrium systems, etc),
- the GdR CoDFT,
- the GdR Maths et entreprise,
- the GdR correl (correlated methods in electronic structure computations).

7.3. European Community financed activities

S. Olla has been awarded an ERC advanced grant No 246953, Malady (Microscopic Laws and Dynamical System, 2010-2015). He is the CoPI with Carlangelo Liverani.
7.4. International Initiatives

7.4.1. Visits of International Scientists

We invited the following researchers to visit our team:

- O. Zeitouni (University of Minnesota and Technion), February 7-12, 2011,
- H. C. Öttinger (ETH Zürich), March 21-25, 2011,
- Y. Efendiev (Texas A & M University), June 6 - July 6, 2011,
- A. Yannacopoulos (Athens University), November 14-18, 2011,
- C. Hartmann (Freie Universität Berlin), November 15-20, 2011.

7.4.2. Bilateral international relations

E. Cancès and V. Ehrlacher are involved in a France-Berkeley project on the modelling of solvated molecules.
6. Partnerships and Cooperations

6.1. National Actions

MISTIS is a partner in a three-year MINALOGIC project (I-VP for Intuitive Vision Programming) supported by the French Government. The project is led by VI Technology (http://www.vitechnology.com), a world leader in Automated Optical Inspection (AOI) of a broad range of electronic components. The other partners involved are the CMM (Centre de Morphologie Mathématiques) in Fontainebleau, and Pige Electronique in Bourg-Les-Valence. The NOESIS company, which is a leader in the field of image processing and analysis software, in Crolles, is also involved to provide help with software development. The overall goal is to exploit statistical and image processing techniques more intensively to improve defect detection capability and programming time based on existing AOI principles so as to eventually reach a reliable defect detection with virtually zero programming skills and efforts.

MISTIS is also involved in another three-year MINALOGIC project, called OPTYMIST-II. The goal is to address variability issues when designing electronic components.

MISTIS got, for the period 2008-2011, Ministry grants for two projects supported by the French National Research Agency (ANR):

- MDCO (Masse de Données et Connaissances) program. This three-year project is called "Visualisation et analyse d’images hyperspectrales multidimensionnelles en Astrophysique" (VAHINE). It aims at developing physical as well as mathematical models, algorithms, and software able to deal efficiently with hyperspectral multi-angle data but also with any other kind of large hyperspectral dataset (astronomical or experimental). It involves the Observatoire de la Côte d’Azur (Nice), and two universities (Strasbourg I and Grenoble I). For more information please visit the associated web site: http://mistis.inrialpes.fr/vahine/dokuwiki/doku.php.

- VMC (Vulnérabilité : Milieux et climats) program. This three-year project is called "Forecast and projection in climate scenario of Mediterranean intense events: Uncertainties and Propagation on environment" (MEDUP) and deals with the quantification and identification of sources of uncertainties associated with forecasting and climate projection for Mediterranean high-impact weather events. The propagation of these uncertainties on the environment is also considered, as well as how they may combine with the intrinsic uncertainties of the vulnerability and risk analysis methods. It involves Météo-France and three universities (Paris VI, Grenoble I and Toulouse III). (http://www.cnrm.meteo.fr/medup/).

Florence Forbes is coordinating the 2-year INRIA ARC project AINSI (http://thalie.ujf-grenoble.fr/ainsi). AINSI stands for "Modeles statistiques pour l’Assimilation d’Informations de Neuroimagerie fonctionnelle et de perfusion cerebrale". The goal is to propose an innovative statistically well-based solution to the joint determination of neural activity and brain vascularization by combining BOLD contrast images obtained in functional MRI and quantitative parametric images (Arterial Spin Labelling: ASL). The partners involved are Visages team from INRIA in Rennes and Parietal in Saclay, the INSERM Unit U594 (Grenoble Institute of Neuroscience) and the LNAO laboratory from CEA NeuroSpin.

6.2. Regional Initiatives

MISTIS participates in the weekly statistical seminar of Grenoble. F. Forbes is one of the organizers and several lecturers have been invited in this context.
6.3. European Initiatives

6.3.1. FP7 Projet

6.3.1.1. HUMAVIPS

Title: Humanoids with audiovisual skills in populated spaces
Type: COOPERATION (ICT)
Defi: Cognitive Systems and Robotics
Instrument: Specific Targeted Research Project (STREP)
Duration: February 2010 - January 2013
Coordinator: INRIA (France)
Others partners: CTU Prague (Czech Republic), University of Bielefeld (Germany), IDIAP (Switzerland), Aldebaran Robotics (France)
See also: http://humavips.inrialpes.fr

Abstract: Humanoids expected to collaborate with people should be able to interact with them in the most natural way. This involves significant perceptual, communication, and motor processes, operating in a coordinated fashion. Consider a social gathering scenario where a humanoid is expected to possess certain social skills. It should be able to explore a populated space, to localize people and to determine their status, to decide to join one or two persons, to synthesize appropriate behavior, and to engage in dialog with them. Humans appear to solve these tasks routinely by integrating the often complementary information provided by multi sensory data processing, from low-level 3D object positioning to high-level gesture recognition and dialog handling. Understanding the world from unrestricted sensorial data, recognizing people’s intentions and behaving like them are extremely challenging problems. The objective of HUMAVIPS is to endow humanoid robots with audiovisual (AV) abilities: exploration, recognition, and interaction, such that they exhibit adequate behavior when dealing with a group of people. Proposed research and technological developments will emphasize the role played by multimodal perception within principled models of human-robot interaction and of humanoid behavior. An adequate architecture will implement auditory and visual skills onto a fully programmable humanoid robot. An open-source software platform will be developed to foster dissemination and to ensure exploitation beyond the lifetime of the project. The MISTIS contribution will consist in developing statistical machine learning techniques for interactive robotic applications.

6.4. International Initiatives

6.4.1. Visits of International Scientists

6.4.1.1. Internships

Federico Raimondo (from Jul 2011 until Dec 2011)
Subject: Parallel Self-Adaptive Evolutionary Optimization Framework on GPU
Institution: Universidad de Buenos Aires (Argentina)

El Hadji DEME (from Apr 2011 until Dec 2011)
Subject: Estimation de copules extremaux, de la densite spectrale multivariee et applications : Biologie et changements climatiques
Institution: Universite Gaston Berger (Senegal)
MODAL Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Christophe Biernacki and Julien Jacques:
- Institut de Biologie de Lille, laboratory Génomique et Maladies Métaboliques, L. Yengo

Christophe Biernacki:
- Industrial studies, Arcelor-Mittal, C. Théry

Julien Jacques:
- Genes Diffusion, J. Hamon

Guillemette Marot:
- Institut Pasteur Lille, Équipe Etudes Transcriptomiques et Génomiques Appliquées, D. Hot,
- Institut Pasteur Lille, Équipe Peste et Yersinia pestis, F. Sebbane
- Institut de Biologie de Lille, Unité d’approches fonctionnelle et structurale des cancers, O. Pluquet
- Université Lille 2, Plate-forme de génomique fonctionnelle et Structurale, M. Figeac
- CHRU Lille, Centre de Biologie Pathologie, Laboratoire d’Hématologie, C. Preudhomme

Cristian Preda:
- ASEL (Association Septentrionale pour l’Etude de Lymphomes) and CRESGE (Centre de Recherches Economiques Sociologiques et de Gestion) from Lille

8.2. National Initiatives

- Alain Célisse co-organized a workshop on Random Graphs in Lille on April ’11 [http://math.univ-lille1.fr/~tran/journeesgraphesaleatoires.html]. There were about 50 applicants, about 12 one-hour talks, one lecture (4 hours and a half) on probabilistic aspects on random graphs by Remco von der Hofstad
- Guillemette Marot belongs to the StatOmique working group [http://vim-iip.jouy.inra.fr:8080/statomique/]

8.3. European Initiatives

8.3.1. Major European Organizations with which you have followed Collaborations

Partner 1: University of Granada, Department of Statistics (Spain)
Collaboration with Professor Ana Aguilera in the field of Functional Data Analysis. Form of collaboration: joint paper[4], ERASMUS mobility, conference organization.

Partner 2: Luxembourg School of Finance (Luxembourg)
Collaboration with Professor Jang Schiltz for time-series prediction using functional data. Form of collaboration: joint paper [25], mobility projects research.

NACHOS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

The team is collaborating with CETE Méditerranée http://www.cete-mediterranee.fr/gb which is a regional technical and engineering centre whose activities are concerned with seismic risk assessment studies. The PhD thesis of Fabien Peyrusse is co-funded by a fellowship from the PACA regional council and a research grant with IFSTTAR http://www.ifsttar.fr (French institute of sciences and technology for transport, development and networks) and CETE Méditerranée.

8.2. European Initiatives

Prof. Martin Gander: University of Geneva, Mathematics section (Switzerland)
Domain decomposition methods (optimized Schwarz algorithms) for the solution of the frequency domain Maxwell equations

Dr. Maciej Klemm: University of Bristol, Communication Systems & Networks Laboratory, Centre for Communications Research (United Kingdom)
Numerical modeling of the propagation of electromagnetic waves in biological tissues with biomedical applications

8.3. Teaching

Claire Scheid and Stéphane Lanteri, Introduction to scientific computing, MathMods - Erasmus Mundus MSc Course, 30 h, University of Nice-Sophia Antipolis.
Claire Scheid, Practicl works on differential equations, 36 h, L3, University of Nice-Sophia Antipolis.
Victorita Dolean and Stéphane Lanteri, Computational electromagnetics, MAM5, 30 h, Polytech Nice.
Victorita Dolean, Ecole thematique CNRS Decomposition de domaine, Frejus 14-18 Novembre, Introductions aux methodes de Schwarz, doctoral level, 6h.

8.4. Ongoing PhD theses

PhD in progress : Joseph Charles, Arbitrarily high-order discontinuous Galerkin methods on simplicial meshes for time domain electromagnetics, University of Nice-Sophia Antipolis, 01/10/2008, Stéphane Lanteri.
PhD in progress : Clément Durochat, Discontinuous Galerkin methods on hybrid meshes for time domain electromagnetics, University of Nice-Sophia Antipolis, 01/10/2009, Stéphane Lanteri.
PhD in progress : Mohamed El Bouajaji, Optimized Schwarz algorithms for the time harmonic Maxwell equations discretized by discontinuous Galerkin methods, University of Nice-Sophia Antipolis, 01/20/2008, Victorita Dolean and Stéphane Lanteri.
PhD in progress : Caroline Girard, Numerical modeling of the electromagnetic susceptibility of innovative planar circuits, Stéphane Lanteri, Ronan Perrussel and Nathalie Raveu (Laplace Laboratory, INP/ENSEEIHT/UPS, Toulouse).
PhD in progress : Ludovic Moya, Numerical modeling of electromagnetic wave propagation in biological tissues, University of Nice-Sophia Antipolis, 01/10/2010, Stéphane Descombes and Stéphane Lanteri.
PhD in progress : Fabien Peyrusse, Numerical simulation of strong earthquakes by a discontinuous Galerkin method, University of Nice-Sophia Antipolis, 01/10/2010, Nathalie Glinsky and Stéphane Lanteri.
NANO-D Team

7. Partnerships and Cooperations

7.1. National Initiatives

NANO-D is currently receiving funding from four ANR programs:

- **ANR JCJC**: 340,000 Euros over three years (2011-2014). This grant has been provided to S. Redon by the French Research Agency for being a finalist in the ERC Starting Grant 2009 call, and is for two PhD students and an engineer.

- **ANR MN**: 180,000 Euros over four years (2011-2015). This project, coordinated by NANO-D (S. Grudinin), gathers biologists and computer scientists from three research groups: Dave Ritchie at LORIA, Valentin Gordeliy at IBS (total grant: 360,000 Euros).

- **ANR COSINUS**: 85,000 Euros over four years (2009-2012). This project, coordinated by NANO-D (S. Redon), gathers physicists, biologists and computer scientists from five research groups: Xavier Bouju and Christian Joachim at CEMES, Martin J. Field at IBS, Serge Crouzy at CEA/LCBM, Thierry Deutsch and Frederic Lançon at CEA/SP2M (total grant: 380,000 Euros).

- **ANR PIRIBio**: 25,000 Euros over four years (2010-2013). We are participating in this project coordinated by Michel Vivaudou at IBS, with Serge Crouzy at CEA/LCBM and Frank Fieschi at IBS.

7.2. International Initiatives

7.2.1. Visits of International Scientists

7.2.1.1. Professors


7.2.1.2. Internship

Petrus Popov

Subject: Conformational sampling strategies for macromolecules

Institution: M.M. Shemyakin & Yu.A. Ovchinnikov Institute of Bioorganic Chemistry (Russia (Russian Federation))
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Pôle de compétitivité Minalogic/ARAVIS

ARAVIS (Architecture reconfigurable et asynchrone intégrée sur puce) is a project sponsored by the Minalogic Pole, started in October 2007 for 3 years (http://www.minalogic.com/PAR_TPL_IDENTIFIANT/903/TPL_CODE/TPL_PROJET/31-recherche.htm). The project has been extended to December 2011. The innovation key deals with bringing architecture and design solutions to calculation platform problems for embedded systems at the 32-nm and 22-nm scales by combining three core technologies:

- ST’s DSPfabric coarse-grain structure, which aims to implement several dozen identical data paths on the same System-on-Chip (SoC) and to reconfigure them according to the needs of the application.
- Techniques based on asynchronous logic (in other words, without a clock) to resolve issues arising from the variability of physical characteristics within each processing node.
- Advanced automatic techniques for dynamic power and activity management according to often contradictory demands such as low voltage and calculation power.

The project is headed by STMicroelectronics, the other partners are CEA-Leti, TIMA laboratory and the SARDIES and NECS teams at INRIA. Previous works on a high-performance controller development for a novel discrete DVS converter were done within this project [14].

8.2. National Initiatives

8.2.1. ANR CONNECT

CONNECT (CONtrol of NEtworked Cooperative sysTem) is a project funded by the ANR (National Research agency). The project deals with the problem of controlling multi-agent systems, i.e. systems composed of several sub-systems interconnected between them by an heterogeneous wireless communication network. In particular, the project target the control of a cluster of agents composed of autonomous underwater vehicles and marine surface vessels. The main challenge here is to learn how to design collaborative controllers accounting for marine communication constraint, but also on the possibility to share computational resources during the system operation. Questions on control architecture in terms of the level of control distribution and control coordination are addressed as well. A generic and open simulation tool able to integrate the various kinds of component’s models found in such a networked multi-agents system are developed and used to assess the related theoretical studies. Potential missions that can be effectuated by this control approach include:

1) Undersea mapping and monitoring via fleets of autonomous underwater vehicles (AUVs),
2) Relocate an aircraft’s black box after crashing into the sea,
3) Detection of industrial or military garbage or mines,
4) Source detection by gradient search (fresh water, chemical source, methane vent,...).

The partners are the NECS team, Ifremer robotics lab. and the ROBOSOFT and Prolexia companies. It started in May 2007, for a duration of 3 and a half years. The project end was in March 2011. More information can be found on-line: http://www.gipsa-lab.inpg.fr/projet/connect/.

8.2.2. ANR VOLHAND

VOLHAND (VOLant pour personne âgée et/ou HANDicapée) is a project funded by the ANR (National Research agency). This project, started in October 2009, is a result of collaboration between C. Canudas de Wit and Franck Quaine/Violaine Cahué (from the biomechanical team of GIPSA-Lab). The project aims at developing a new generation of Electrical power-assisted steering specifically designed for disabled and aged people. Our contribution is to work out new assisted laws that accommodate to the specific mechanical characteristics of this particular driver population. The consortium is composed by: LAMIH, CHRU, Fondation Hopale, GIPSA-Lab, INRETS and JTEKT. More information can be found on-line: http://www.univ-valenciennes.fr/volhand/.
8.3. European Initiatives

8.3.1. FeedNetBack

The FeedNetBack proposal has been accepted as a STREP project at the FP7-ICT-2007-2 call in October 2007, for a duration of three years and will end in January 2012. It is coordinated by C. Canudas de Wit and gathers researchers from academia (INRIA-NeCS, ETH Zurich, Universidad de Sevilla, KTH Stockholm, Universita di Padova) and from industry (Ifremer, Videotec and OMG). The main objective of the FeedNetBack project is to generate a rigorous co-design framework that integrates architectural constraints and performance trade-offs from control, communication, computation, complexity and energy management.

The goal is to master complexity, temporal and spatial uncertainties such as delays and bandwidth in communications and node availability. This approach enabled the development of more efficient, robust and affordable networked control systems that scale and adapt with changing application demands. The project extend the current scientific state-of-the-art in networked control and develop a set of software tools to support the co-design framework. To demonstrate the potential and limitations of the new technology, FeedNetBack applies it on two industrial test cases of realistic complexity and scale: underwater inspection systems based on fleets of Autonomous Underwater Vehicles (AUVs), and surveillance systems using a network of smart cameras. The control component is essential in both test cases as they require cooperation of distributed objects to achieve a common goal (http://feednetback.eu/).

Specific issues are addressed in the project:

- Heterogeneity: The sensor hardware and the communication means may be of different natures (different noises, bandwidths, resolution characteristics, etc.).
- Mobility: Sensor location may not be fixed. Dynamic location of sensors will lead to varying topologies.
- Resource management: The energy and computation capabilities of each node are generally limited.
- Scalability: Wireless sensor networks may comprise hundreds or thousands of nodes. It is therefore crucial that the complexity of the design procedures and the resulting controllers scale slowly with the number of nodes.
- Asynchrony: Information exchange between sensor/control units may not be synchronous in time.

Since in NCS the goal is to ensure satisfactory performance of the overall closed loop system, these problems are treated holistically through sets of performance constraints. The co-design framework aims at controlling more complex systems with a fraction of the effort, while increasing availability and reliability. The framework will enable application developers, programmers and systems integrators to fully use the potential of networked control in a wide set of industrial domains. Examples of areas where an impact is expected are the fields of factory automation, public infrastructure safety and security, transport and building maintenance. New technologies have been developed and applied in FeedNetBack to areas of society where they protect the environment and improve people’s safety, security and ultimately quality of life.

8.3.2. HYCON2

HYCON2 (Highly-Complex and Networked Control Systems) is a Network of Excellence, within the European Union’s FP7. It has started on September 2010, for a duration of three years. Coordinated by Françoise Lamnabhi-Lagarrigue (L2S-CNRS), it involves 26 academic institutions from all over Europe. ICT developments both enable and enforce large-scale, highly-connected systems in society and industry, but knowledge to cope with these emerging systems is still lacking. HYCON2 will stimulate and establish the long-term integration of the European research community, leading institutions and industry in the strategic field of control of complex, large-scale, and networked dynamical systems.

HYCON2 will assess and coordinate basic and applied research, from fundamental analytical properties of complex systems to control design methodologies with networking, self-organizing and system-wide coordination. HYCON2 has identified several applications domains to motivate, integrate, and evaluate research in networked control. These domains are ground and aerospace transportation, electrical power networks, process industries, and biological and medical systems. Benchmarking will serve as a tool for testing and evaluating the technologies developed in HYCON2 and for
stimulating and enforcing excellence by the identification and adoption of best practices. In particular, two show-case applications corresponding to real-world problems have been selected in order to demonstrate the applicability of networked control and the need for research in control. The proposed research, integration and dissemination program will make Europe both the prominent scientific and the industrial leader in the area of highly complex and networked control systems, therefore posing Europe in an extraordinary position to exploit their impact in economy and society.

The NeCS team is mainly involved in the first show case application, which corresponds to the operation of the freeway network around the Grenoble area. The recent advent of new vehicle sensing technologies provides an opportunity for innovative control applications in traffic management. The Grenoble Traffic Lab (GTL) initiative, lead by the NeCS team, has the ambition to equip massively the Grenoble south beltway with wireless magnetometers. The availability of such a reliable sensor network, designed primarily with control applications in mind, will allow to see control systems used in the field of freeway management. Control systems in road transportation are primarily involved in the management of traffic lights in urban (city corridors), and inter-urban sectors (rings highways). The target of most of the efforts in the domain is to improve the freeway efficient in an equal way to all drivers. The goal of this show case is to provide a rich set of field traffic data to the control community in order to test their algorithms on a practical real-world problem. These data will be available through a web server administered by INRIA along with all the maps describing finely the freeway under study. Historical and real time data will be available. All these data will be ready for experiments and the outcomes can be provided to the road operators to judge the relevance and efficiency of the results for operational use.

8.3.3. TeMP

TeMP (Tensor-based Information modelling and Processing) is a project funded in the framework of the French-Brazilian bilateral collaboration program (FUNCAP-INRIA). It started from August 2011 for a duration of two years and is coordinated for the French part by A. Kibangou. This project aims to study, analyze, propose and evaluate new models and techniques for digital communication systems using tensors and multilinear algebra tools, through in-depth theoretical analysis of mathematical models, optimization algorithms, and computational simulations. Indeed, new models should be developed for generalizing existing tensor models in order to allow the modeling of a wider class of communication systems for more realistic propagation channels including the cooperation among multiple nodes of a communication network (users or sensors). Due to dynamic change of parameters, tensor-based filtering algorithms need to be developed for information retrieval systems in cooperative communication. These algorithms should be distributed for avoiding network vulnerability and for a better management of computation and storage resources.

8.4. National and International Initiatives

8.4.1. INRIA Associate Teams

- The NeCS team is a partner in the Sensas A.D.T. (started in December 2010), where it is involved in the coordinated control of a networked swarm of mobile robots.

8.4.2. INRIA National and International Partners

Long term collaboration does exist with the University of Sevilla along several different topics including: coding and control co-design, Power control in NCS, energy-aware control in SoC, and control of DC/AC converters. Scientific collaborations inside the IST FeedNetBack project have been initialized with ETH Zurich and University of Sevilla about the integration of control and scheduling on distributed architectures, in particular focusing on the robustness and predictive control point of views. The ANR SafeNecs project provided support and collaboration along the three past years with teams from both the computing side (LORIA Trio team about control and (m,k)-firm scheduling) and from the fault tolerant control side (CRAN Nancy and GIPSA-LAB, about the integration of real-time control, diagnosis and flexible scheduling). Strong collaborations have been established with KTH (Stockholm), ETH (Zurich), University of Sevilla and Padova as core partners of the FeedNetBack European project.
• C. Canudas de Wit has collaborations with University of Sevilla, Spain (F. Gomez-Estern, F. R. Rubio, F. Gordillo, J. Aracil).
• A. Seuret has collaborations with LAGIS, Lille (J.-P. Richard), Leicester University, UK (C. Edwards), University of Kent, UK (S.K. Spurgeon), Tel Aviv University, Israel (E. Fridman), Universidade Federal do Rio Grande do Sul, Brasil (J.M. Gomes da Silva Jr.), KTH, Sweden (K.H. Johansson, D.V. Dimarogonas, C. Briat), Illinois Institute of Technology, USA (M.M. Peet) and Cinevstav, Mexico (S. Mondié).
• D. Simon spent one week in the Department of Automatic Control and Systems Engineering, University of Sevilla (25-29/04/2011), working with David Muñoz on the integration of MPC based schedulers and LPV varying sampling control loops.
• A. Kibangou has collaborations with I3S, Nice (G. Favier) and Universidade Federal do Ceara, Brazil (A.L.F. De Almeida).
• F. Garin has collaborations with Università di Padova, Italy (R. Carli, E. Lovisari, S. Zampieri) and Politecnico di Torino, Italy (P. Frasca, F. Fagnani) and with MIT, USA (G. Como).
• H. Fourati has started a new collaboration with the Kazakhstan National Technical University (KazNTU). He currently co-advises with Pr. Syzdikov Dastan Jacanovich in KazNTU, Zarina Samigulina PhD student in KazNTU. He has also some collaborations with CReSTIC/University of Reims Champagne Ardenne (N. Manamanni) and DEPE/IPHC/University of Strasbourg (Y. Han- drich).

8.4.3. Visits of International Scientists
• Dr. Daniel Quevedo from the University of Newcastle (Australia) has visited the NeCS team for one week in September 2011.
• Enrico Lovisari, PhD student at Università di Padova has visited the NeCS team for one week in July 2011.
• Fabio Gomez-Estern from University of Sevilla has visited the NeCS team for 3 weeks in January 2011.
• Pr. Sabine Mondie from PCinvestav, Mexico has visited the NeCS team in September 2011.
• Pr. Valter Leite from CEFET–MG, Campus Divinopolis, Brasil has visited the NeCS team during 2011.
7. Partnerships and Cooperations

7.1. Regional Initiatives

- Grant from GRAISyHM (Groupement de Recherche en Automatisation Intégrée et Systèmes Homme-Machine, governmental Federation and Regional Council) on networked control (results connected with delay systems), with LAGIS and LAMIH (CNRS-UVHC Valenciennes).

7.2. National Initiatives

- We are involved in several technical groups of the GDR MACS (CNRS, "Modélisation, Analyse de Conduite des Systèmes dynamiques", see http://www.univ-valenciennes.fr/GDR-MACS ), in particular: Technical Groups "Identification", "Time Delay Systems", "Hybrid Systems" and "Control in Electrical Engineering".
- Model-free control: collaborations with Professor Brigitte D’Andréa-Novel at Mines ParisTech and Professor Emmanuel Delaleau at ENIB (Brest).
- Atomic Force Microscope (AFM): application of new algebraic methods in tapping mode for AFM, collaboration with the National Laboratory of Metrology (LNE) located at Trappes.

7.3. European Initiatives

- Collaboration with Sarah Spurgeon of University of Kent on Sliding mode control;
- Collaboration with Emmanuel Brousseau of Cardiff University for the project: "on nano mechanical machining of 3D nano structures by AFM".

7.4. International Initiatives

- Collaboration with Professors Emilia Fridman (Tel Aviv University) and Joao Manoel Gomes da Silva (UFRGS, Porto Allegre, Brasil) on time-delay systems.
- Collaboration with Professor Hong Sun (Whuan University, China) for co-supervising the PhD thesis of Lei Yu on Compressive sensing.
- Collaborations with Professor Guiseppe Fedele from University of Calabria, Italy, on "Model-free control".
- Programme Hubert Curien GALILEE for scientific exchange between LAGIS and University of Cagliari, Italy;
- Programme Hubert Curien VOLUBILIS (Maroc, Integrated Action MA/09/211) between LAGIS (Université Lille1), Non-A/INRIA and Laboratory of Electronic, Information and Biotechnology of Department of Science at University Moulay Ismail of Meknès;
- Programme Hubert Curien COGITO for scientific exchange between University of Reims Champagne Ardenne, Non-A and University of Zagreb.
8. Partnerships and Cooperations

8.1. International Initiatives

8.1.1. INRIA International Partners

Montreal University, Centre de Recherches Mathématiques CRM, Canada.

Shape and geometries (M. Delfour and J.-P. Zolésio).

8.1.2. Visits of International Scientists

8.1.2.1. Internship

Jihed Joobeur (from Mar 2011 until Aug 2011)

Subject: Crowd data collection from video recordings

Institution: Ecole Nationale d’Ingénieurs de Tunis (ENIT) (Tunisia)

8.1.3. Participation In International Programs

- Euromed 3+3 Project SCOmu 2009-2011:

  Opale is the French coordinator for the project "Scientific Computing and Multidisciplinary Optimization" (SCOMU), a Euro-Mediterranean Euromed 3+3 program. The project SCOMU involves institutions from France (INRIA, Opale Project, Nice Sophia Antipolis University), Italy (University of Genova), Spain (University of Corogna), Tunisia (ENIT, Tunis) and Morocco (Ecole Mohammedia, University Mohamed V, Rabat). The project is a three-year financed action. The SCOmu project has successfully allowed researchers from the Maghreb and Euro-Mediterranean regions to exchange their modeling and analysis skills in the fields of numerical analysis, optimization and game theory. The partner teams developed applications of game theory in new areas which have strategic interests such as imaging, mathematical finance, structural mechanics and mathematics for life sciences.

- LIRIMA Team ANO 2010-2013:

  The agreement governing the creation of the International Laboratory for Research in Computer Science and Applied Mathematics (LIRIMA) was signed on 24th November 2009 in Yaoundé. LIRIMA enables cooperation between INRIA research teams and teams in Africa (Sub-Saharan Africa and the Maghreb) to be reinforced. It is the continuation of the major operation undertaken by the SARIMA program (2004-08 – Priority Solidarity Fund created by the French Ministry of Foreign & European Affairs). The LIRIMA team ANO: Numerical analysis of PDEs and Optimization is a partnership between Opale project and the EMI engineering college, Rabat / National Centre for Scientific and Technical Research (CNRST) Morocco. The Team leader is Prof. Rajae Aboulaich, EMI.
8. Partnerships and Cooperations

8.1. National Initiatives

- GDR Ultrasons: this GDR, which regroups more than 15 academic and industrial research laboratories in Acoustics and Applied Mathematics working on nondestructive testing. It has been renewed this year with the participation of Great Britain.

- ANR project AEROSON: Simulation numérique du rayonnement sonore dans des géométries complexes en présence d’écoulements réalistes
  Partners: EADS-IW, CERFACS, Laboratoire d’Acoustique de l’Université du Maine.

- ANR project PROCOMEDIA: Propagation d’ondes en milieux complexes
  Partners: ESPCI, Laboratoire d’Acoustique de l’Université du Maine, Departamento de Fisica de la Universidad de Chile.

- ANR project METAMATH: modélisation mathématique et numérique pour la propagation des ondes en présence de méta matériaux.
  Partners: EPI DEFI (INRIA Saclay), IMATH-Université de Toulon, DMIA-ISAE.

8.2. European Initiatives

8.2.1. FP7 Projet

8.2.1.1. SIMPOSIUM

Title: Simulation Platform for Non Destructive Evaluation of Structures and Materials
Type: COOPERATION (ICT)
Defi: PPP FoF: Digital factories: Manufacturing design and product lifecycle manage
Instrument: Integrated Project (IP)
Duration: September 2011 - August 2014
Coordinator: CEA (Philippe Lecestre) (France)
Others partners: SERCO LIMITED (UNITED KINGDOM), SIMULAYT LTD (UNITED KINGDOM), SKF SVERIGE AB (SWEDEN), UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II (ITALY), UNIVERSITA DEGLI STUDI DI CASSINO (ITALY), VOLKSWAGEN AG (GERMANY), ARCELORMITTAL MAIZIÈRES RESEARCH SA (FRANCE), EXTENDE (FRANCE), EUROPEAN AERONAUTIC DEFENCE AND SPACE COMPANY EADS FRANCE SAS (FRANCE), IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE (UNITED KINGDOM), SAARSCHMIEDE GMBH FREIFORMSCHMIEDE* (GERMANY), KATHOLIEKE UNIVERSITEIT LEUVEN (BELGIUM), FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V (GERMANY).
See also: http://cordis.europa.eu/fetch?CALLER=PROJ_ICT&ACTION=D&CAT=PROJ&RCN=99653

8.3. International Initiatives

8.3.1. Visits of International Scientists

- Ricardo Weder, Professor at the Universidad Nacional Autónoma de Mexico.
- Gerardo Daniel Valencia, Professor at the Universidad Nacional Autónoma de Mexico.
PUMAS Team

6. Partnerships and Cooperations

6.1. National Actions

6.1.1. ANR ESPOIR

The ANR ESPOIR (Edge Simulation of the Physics Of Iter Relevant turbulent transport) associates the PUMAS team with the M2P2, LPIIM and LATP laboratories in Marseille and IRFM in Cadarache to investigate edge plasma turbulence. The numerical simulation of the plasma wall interactions requires efficient codes and thus the development of advanced numerical methods and solvers. The aim of this project is to study different numerical strategies for edge plasma models in the real geometrical and magnetical configurations corresponding to the future Iter machine.

6.1.2. ANEMOS : ANR-11-MONU-002

ANEMOS : Advanced Numeric for Elms : Models and Optimized Strategies associates JAD Laboratory/Inria (Nice, Manager), IRFM-CEA (Cadarache), “Maison de la Simulation (Saclay)” and Inria EPI Bacchus (Bordeaux)

Elms are disruptive instabilities occurring in the edge region (SOL) of a tokamak plasma. The development of Elms poses a major challenge in magnetic fusion research with tokamaks, as these instabilities can damage plasma-facing components, particularly divertor plates. The mitigation or suppression of large Elms is a critical issue for successful operation of ITER. Goal for ANEMOS is to develop and improve numerical tools in order to simulate physical mechanisms of Elms and qualifies some strategies for their control. We then need to design efficient numerical strategies on the most advanced computers available such as to contribute to the science base underlying of proposed burning plasma tokamak experiments such as ITER.

6.2. International Grants

6.2.1. 3+3 Euro méditerranée project Mhycof

This project associates the University Ibn Zohr, Agadir, the Mohamedia Engineering school, the university of Oujda in Morocco, the University of Pisa (Italy) the Universidad de Zaragoza (Spain), the Polytechnic school of Tunisia, the university of Paris 13 and Inria Sophia-Antipolis to develop numerical modelling of coastal flows.

6.2.2. Bilateral Scientific Relations

6.2.2.1. Institute of Mathematical Modeling, Moscow : Acoustics

Participants: Alain Dervieux, Tatiana Kozubskaya [IMM-Moscow], ILya Abalakin [IMM-Moscou].

The long-term scientific collaboration with IMM on acoustics focussed this year on new reconstruction schemes for noise propagation with linear and non-linear hyperbolic models.

6.2.2.2. Ingegneria Aerospaziale, university of Pisa : Turbulence Modeling & Environmental flows.

Participants: Hervé Guillard, Alain Dervieux, Bruno Koobus [Montpellier 2], Simone Camarri [University of Pisa], Maria-Vittoria Salvetti [University of Pisa].

The long-term scientific collaboration with the Department of Ingegneria Aerospaziale at university of Pisa has concerned during last years complex fluid flows with cavitation. It continues with the development of hybrid models for turbulent flows and a common work on the transport of sediment in shallow water flows in the context of the EuroMed 3+3 project MHyCoF.
6.2.2.3. Texas A & M: High order methods

Participants: Jean-Luc Guermond [Texas A & M University], Richard Pasquetti.

This collaboration involves the development of techniques to compute solutions of non-linear hyperbolic problems by the use of artificial viscosity. The main idea is here to introduce a non-linear viscous term whose strength is derived from the residual of the entropy equation associated to the considered PDE.

6.2.2.4. University of Pilsen, Czech Republic

Participants: Petr Vanek [University of Pilsen], Hervé Guillard.

The collaboration with the University concerns the development of algebraic multigrid solvers for large scale problems encountered in physics modelling and engineering.
8. Partnerships and Cooperations

8.1. International Initiatives

8.1.1. ANR Gratel

André Raspaud launched in 2005 a fruitful cooperation with the Department of Applied Mathematics of the Sun Yat-Sen University of Kaohsiung, Taiwan. This gave rise to an international ANR project funded for three years (January 2010 - December 2013), that is managed by Arnaud Pêcher. The scientific priority theme is “Telecommunications”, a well-known key application area of graph theory. The aim is to tackle especially wireless communications problems, with the help of graph colorings and polyhedral graph theory. Currently, Sagnik Sen (PhD student of E. Sopena, A. Pêcher, A. Raspaud) benefits from a scholarship on this ANR.

8.1.2. INRIA Associate Team: SAMBA

| Title: Synergies for Ameliorations and Mastering of Branch-and-price Algorithms |
| INRIA principal investigator: François Vanderbeck |
| International Partner: |
| Institution: Pontificia Universidade Catolica do Rio de Janeiro (Brazil) |
| Laboratory: ATD-Lab |
| Researcher: Marcus Poggi, Artur Pessoa, and Eduardo Uchoa |

Duration: 2011 - 2013

See also: https://wiki.bordeaux.inria.fr/realopt/pmwiki.php/Project/Samba

The so-called Dantzig-Wolfe decomposition approach has not yet made its way into general purpose solvers for Mixed Integer Programming (MIP). Despite its proved efficiency, the use of the method is currently restricted to specific applications and requires ad-hoc algorithms developed by experts. Our project is to develop general purpose algorithms to make this method generic. We shall focus in particular on (i) preprocessing procedures, (ii) warm-starting, (iii) stabilization (to improve convergence), (iv) strategies for combining cut and column generation, and (v) primal heuristics. The project builds on the accumulated experience of both the Brazilian and the French teams that have done pioneering work in tackling complex applications and deriving generic solution strategies using this decomposition approach. The new algorithms shall be implemented and tested in the software platform BaPCod. (BaPCod is a generic Branch-and-Price code developed by ReAlOpt as a C++ library that is build as a layer above MIP solvers.) Hence, the collaborative research on methodological developments should lead to, as a bi-product, a Version 2 of BaPCod as a state-of-the-art Branch-and-Price-and-Cut Solver. This prototype should (i) serve as proof-of-concept code for the research planned in this project and beyond, (ii) enable us to achieve new benchmark results on key problems, (iii) provide incentive for the use of the method by non experts, (iv) leverage technology transfer to industry.

8.1.3. Visits of International Scientists

8.1.3.1. Short term Visitors

- Mathieu Van Vyve, CORE and LSM, Université catholique de Louvain, Belgium.
- Claudia d’Ambrosio, DEIS, Università di Bologna, Italy.
- Marcus Poggi, Departamento de Informatica, PUC-Rio, Brazil.
• Artur Pessoa, LOGIS, the Universidade Federal Fluminense, Brazil.
• Eduardo Uchoa, LOGIS, the Universidade Federal Fluminense, Brazil.

8.1.3.2. Internships

• Master internship: Damien Trut: "Collecting Containers: operationnal planning", March - September 2011, F. Vanderbeck, R. Sadykov
8. Partnerships and Cooperations

8.1. Regional Initiatives

The Regularity team collaborates with Supelec (Hana Baili) and with the Department of Mathematics at the University of Nantes (Anne Philippe) in the frame of the DIGITEO ANIFRAC project.

8.2. National Initiatives

Regularity participates in the CSDL project of the Pôle de Compétitivité SYSTEM@TIC PARIS-REGION. The academic partners involved are ECP, Ecole des Mines de Paris, ENS Cachan, INRIA, Supelec.

8.3. International Initiatives

8.3.1. INRIA International Partners


- The Regularity team collaborates with Michigan State University (Prof. Yimin Xiao) on the study of fine regularity of multiparameter fractional Brownian motion (invitation of Erick Herbin at East Lansing in 2010).

- The Regularity team collaborates with St Andrews University (Prof. Kenneth Falconer) on the study of multistable processes.

- The Regularity team collaborates with Acadia University (Prof. Franklin Mendivil) on the study of fractal strings.

8.3.2. Visits of International Scientists

Ely Merzbach, from Bar Ilan university (Israel) visited the team for one month. Franklin Mendivil, from Acadia University (Canada), visited the team for one month.
8. Partnerships and Cooperations

8.1. National Actions

SELECT is animating a working group on model selection and statistical analysis of genomics data with the Biometrics group of Institut Agronomique Nationale Paris-Grignon (INAPG).

Pascal Massart is co-organizing a working group at ENS (Ulm) on Statistical Learning. This year the group focused interest on regularization methods in regression. Most of SELECT members are involved in this working group.

SELECT is animating a working group on Classification, Statistics and fMRI imaging with Neurospin.

SELECT is animating a working group on Unsupervised Classification with the CMAP (École Polytechnique)

8.2. European Initiatives

Gilles Celeux and Pascal Massart are members of the PASCAL (Pattern Analysis, Statistical Learning and Computational Learning) network.

8.3. International Initiatives

Gilles Celeux is one of the co-organizers of the Working Group on Model-Based Clustering.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. PICOM

see 7.1.5.

8.2. National Initiatives

8.2.1. DGA/Thales

The work on sensor management went on this year, focusing on the extension to the multisensor case of the PHD filter. This work is realized in the frame of the thesis of Emmanuel Delande (Grant DGA/CNRS) in collaboration with Thales Communication. The defense of this PhD thesis will be held in December 2011.

8.2.2. ANR-Lampada

Participants: Mohammad Ghavamzadeh, Jérémie Mary, Olivier Nicol, Philippe Preux, Daniil Ryabko, Christophe Salperwyck.

- Title: Learning Algorithms, Models an sPARse representations for structured DAta
- Type: National Research Agency (ANR-09-EMER-007)
- Coordinator: INRIA Lille - Nord Europe (Mostrare)
- Others partners: Laboratoire d’Informatique Fondamentale de Marseille, Laboratoire Hubert Curien ; Saint Etienne, Laboratoire d’Informatique de Paris 6.
- See also: http://lampada.gforge.inria.fr/
- Activity Report: Philippe Preux has continued his collaboration with Ludovic Denoyer (assistant professor, Université de Paris 6), Gabriel Arnold-Dulac (PhD student), and Patrick Gallinari (professor, Université de Paris 6). This led to the work on datum-wise representation [44], [54].

8.2.3. ANR EXPLO-RA

Participants: Lucian Busoniu, Alexandra Carpentier, Mohammad Ghavamzadeh, Jean-François Hren, Alessandro Lazaric, Odalric-Ambrym Maillard, Rémi Munos, Daniil Ryabko.

- Title: EXPLOration - EXPLOitation for efficient Resource Allocation with Applications to optimization, control, learning, and games
- Type: National Research Agency
- Coordinator: INRIA Lille - Nord Europe (SequeL, Rémi Munos)
- Others partners: INRIA Saclay - Ile de France (TAO), HEC Paris (GREGHEC), Ecole Nationale des Ponts et Chaussées (CERTIS), Université Paris 5 (CRIP5), Université Paris Dauphine (LAMSADE).
- See also: https://sites.google.com/site/anrexplora/
- Activity Report: We developed bandit algorithm for planning in Markov Decision Processes based on the optimism in the face of uncertainty principle.
8.2.4. ANR CO-ADAPT

Participants: Alexandra Carpentier, Rémi Munos.

- Title: Brain computer co-adaptation for better interfaces
- Type: National Research Agency
- Duration: 2009-2013
- Partners: INRIA Odyssee project (Maureen Clerc), the INSERM U821 team (Olivier Bertrand), the Laboratory of Neurobiology of Cognition (CNRS) (Boris Burle) and the laboratory of Analysis, topology and probabilities (CNRS and University of Provence) (Bruno Torresani).
- Activity Report: In collaboration with Maureen Clerc and here student Joan Fruitet, we proposed a new Brain Computer interface procedure to select online a discriminative motor task based on a bandit algorithm. The efficient trading off between exploration (getting information about each motor tasks) and exploitation (selecting those that have highest classification rates) enables to reduce the time of the training session.

8.2.5. ANR AMATIS

Participant: Pierre Chainais.

- Title: Multifractal Analysis and Applications to Signal and Image Processing
- Type: National Research Agency
- Duration: 2011-2015
- Partners: Univ. Paris-Est Créteil, Univ. Sciences et Technologies de Lille and INRIA (Lille=, ENST (Telecom ParisTech), Univ. Blaise Pascal (Clermont-Ferrand), and Univ. Bretagne Sud (Vannes), Statistical Signal Processing group at the Physics Department at the Ecole Normale Supérieure de Lyon, one researcher from the Math. Department of Institut National des Sciences Appliquees de Lyon and two researchers from the Laboratoire d’Analyse, Topologie et Probabilités (LAPT) of Aix-Marseille University.
- Coordinator: Univ. Paris-Est-Créteil (S. Jaffard)
- Activity Report: Ideas from the multifractal framework are the basis of our current work on the development of a new Bayesian approach to the blind deconvolution of noisy images.

8.2.6. National Partners

- INRIA Nancy - Grand Est, Team MAIA, France.
  - Bruno Scherrer Collaborator
  We have had collaboration on the topic of approximate dynamic programming and statistical learning and published a conference paper [25] and a technical report [51] this year.
  - Stéphane Canu Collaborator
  Emmanuel Duflos and Hachem Kadri are collaborating with Pr. Stéphane Canu on Functional RKHS.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. PASCAL-2

- Participants: the whole SEQUEL is involved
- **Title:** Pattern Analysis, Statistical Modeling, and Computational Learning
- **Type:** Cooperation (ICT), Network of Excellence (NoE)
- **Duration:** March 2008 - February 2013
- **Coordinator:** Univ. Southampton
- **Others partners:** Many european organizations, universities, and research centers.
- **See also:** [http://www.pascal-network.org/](http://www.pascal-network.org/)

8.3.1.2. **PASCAL-2 Pump Priming Programme**

**Participants:** Mohammad Ghavamzadeh, Rémi Munos.

- **Title:** Sparse Reinforcement Learning in High Dimensions
- **Type:** PASCAL-2 Pump Priming Programme
- **Duration:** November 2009 - March 2012
- **Partners:** INRIA Lille - Nord Europe, Shie Mannor (Technion, Israel)
- **See also:** [http://sites.google.com/site/sparserl/home](http://sites.google.com/site/sparserl/home)

8.3.1.3. **CompLACS**

**Participants:** Mohammad Ghavamzadeh, Alessandro Lazaric, Rémi Munos, Philippe Preux, Daniil Ryabko.

- **Title:** Composing Learning for Artificial Cognitive Systems
- **Type:** Cooperation (ICT), Specific Targeted Research Project (STREP)
- **Duration:** March 2011 - February 2015
- **Coordinator:** University College of London
- **Partners:** University College London, United Kingdom (John Shawe-Taylor, Stephen Hailes, David Silver, Yee Whye Teh), University of Bristol, United Kingdom (Nello Cristianini), Royal Holloway, United Kingdom (Chris Watkins), Radboud Universiteit Nijmegen, The Netherlands (Bert Kappen), Technische Universitat Berlin, Germany (Manfred Opper), Montanuniversitat Leoben, Austria (Peter Auer), Max-Planck Institute of Biological Cybernetics, Germany (Jan Peters).
- **See also:** [http://www.complacs.org/](http://www.complacs.org/)

8.3.1.4. **PIPER**

**Participant:** Alessandro Lazaric.

- **Title:** New Paradigms for Preventing uncontrolled social influence in the future web
- **Type:** FET-Open Young Explorer Scheme
- **Duration:** Submitted
- **Coordinator:** Politecnico di Milano (Nicola Gatti)
- **Partners:** University of Southampton, United Kingdom (Valentin Robu, Enrico Gerdin, Nick Jennings).
8.4. International Initiatives

8.4.1. INRIA Associate Teams: SEQ-RL

- **Title**: Decision-making under Uncertainty with Applications to Reinforcement Learning, Control, and Games
- **INRIA principal investigator**: Rémi Munos
- **International Partner**:
  - **Institution**: University of Alberta (Canada)
  - **Laboratory**: Department of Computer Science
  - **Principal investigator**: Csaba Szepesvári
- **Duration**: January 2010 - January 2013
- **Website**: [http://sites.google.com/site/associateteamualberta/home](http://sites.google.com/site/associateteamualberta/home)

This associate team aims at bridging researchers from the SequeL team-project at INRIA Lille with the Department of Computing Science of the University of Alberta in Canada. Our common interest lies in machine learning, especially reinforcement learning, bandit algorithms and statistical learning with applications to control and computer games. The department of Computing Science at the University of Alberta is internationally renown as a leading research institute on these topics. The research work spans from theory to applications. Grounded on an already existing scientific collaboration, this associate team will make it easier to collaborate further between the two institutes, and thus strengthen this relationship. We foresee that the associate team will boost our collaboration, create new opportunities for financial support, and open-up a long-term fruitful collaboration between the two institutes. The collaboration will be through organizing workshops and exchanging researchers, postdoctoral fellows, and Ph.D. students between the two institutes.

8.4.2. INRIA International Partners

- University of Alberta, Edmonton, Alberta, Canada.
  - **Prof. Csaba Szepesvari Collaborator**
    We have been working on the topic of regularized reinforcement learning over the last four years. This year, we have one journal paper submitted [57] and one that will be submitted soon [8] on this topic. We are also coordinators of an INRIA associate team program with the university of Alberta.
  - **Amir massoud Farahmand Collaborator**
    We have been working on the topic of regularized reinforcement learning over the last five years. This year, we have one journal paper submitted [57] and one that will be submitted soon [8] on this topic.

- Technion - Israel Institute of Technology, Haifa, Israel.
  - **Prof. Shie Mannor Collaborator**
    We have been collaborating on the topic of Bayesian reinforcement learning for the last six years, on the topic of regularized reinforcement learning for the last four years, and on the topic of reinforcement learning in high dimensions in the last two year. On the first topic, we have a journal paper (survey) in preparation [58] this year. On the second topic, we have one journal paper under review [57] and one in preparation [8] this year. Finally, on the third topic, we were Co-PI’s of a PASCAL2 pump-priming program that ended in June 2011.

- University of Waterloo, Waterloo, Ontario, Canada.
– Prof. Pascal Poupart Collaborator
We have been collaborating on the topic of Bayesian reinforcement learning in the last five years. This year, we have a journal paper in preparation [58] on this topic.

• Politecnico di Milano, Italy.
  – Prof. Marcello Restelli Collaborator
  We have been working on the topic of transfer in reinforcement learning over the last year. In particular, we have one conference paper [32] and a journal paper in preparation.

  – Prof. Nicola Gatti Collaborator
  We have started a collaboration on the topic of bandit mechanisms for sponsored-search auction. This year, we have submitted a paper to AAMAS [26] and we have collaborated on a proposal for a Marie Curie ITN and a Fet-Open Young Researcher proposal.

• University of Southampton, United Kingdom.
  – Prof. Enrico Gerding Collaborator
  We have been working on the topic of learning and mechanism design over the last year. In particular, we have collaborated on a proposal for a Marie Curie ITN and a Fet-Open Young Researcher proposal.

8.4.3. Visits of International Scientists

8.4.3.1. International Scientists

• Brahim Chaib-Draa, from Université Laval, Québec.
  His visit has been funded by Université de Lille 3 where he also taught.

• Mohammad G. Azar, Ph.D. student at University of Nijmegen, The Netherlands.
  Period: April 2011 - July 2011
  He worked with Rémi Munos and Mohammad Ghavamzadeh on performance analysis of reinforcement learning algorithms. The outcome of this collaboration has been a conference paper [16] and a technical report [48] so far.

8.4.3.2. Internship

• Matthew Hoffman, Ph.D. student at University of British Columbia, Canada.
  Period: October 2010 - April 2011.
  He worked with Alessandro Lazaric, Rémi Munos, and Mohammad Ghavamzadeh on our PASCAL2 Pump-Priming project on sparse reinforcement learning in high dimensions. The outcome of this collaboration has been a conference paper [61] so far.
7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR Projects

7.1.1.1. DETECT

Participants: Sylvain Arlot, Francis Bach.

Title: New statistical approaches to computer vision and bioinformatics
Coordinator: École Normale Supérieure (Paris)
Leader of the project: Sylvain Arlot
Other members: J. Sivic (Willow project-team, ENS), A. Celisse (University Lille 1), T. Mary-Huard (AgroParisTech), E. Roquain and F. Villers (University Paris 6).
Instrument: ANR “Young researchers” Program
Duration: Sep 2009 - Aug 2012
Total funding: 70000 Euros
See also: http://www.di.ens.fr/~arlot/ANR-DETECT.htm

Abstract: The DETECT project aims at providing new statistical approaches for detection problems in computer vision (in particular, detecting and recognizing human actions in videos) and bioinformatics (e.g., simultaneously segmenting CGH profiles). These problems are mainly of two different statistical nature: multiple change-point detection (i.e., partitioning a sequence of observations into homogeneous contiguous segments) and multiple tests (i.e., controlling a priori the number of false positives among a large number of tests run simultaneously).

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. SIERRA

Title: SIERRA – Sparse structured methods for machine learning
Type: IDEAS
Instrument: ERC Starting Grant
Duration: December 2009 - November 2014
Coordinator: INRIA (France)
See also: http://www.di.ens.fr/~fbach/sierra

Abstract: Machine learning is now a core part of many research domains, where the abundance of data has forced researchers to rely on automated processing of information. The main current paradigm of application of machine learning techniques consists in two sequential stages: in the representation phase, practitioners first build a large set of features and potential responses for model building or prediction. Then, in the learning phase, off-the-shelf algorithms are used to solve the appropriate data processing tasks.

While this has led to significant advances in many domains, the potential of machine learning techniques is far from being reached: the tenet of this proposal is that to achieve the expected breakthroughs, this two-stage paradigm should be replaced by an integrated process where the
specific structure of a problem is taken into account explicitly in the learning process. Considering such structure appropriately allows the consideration of massive numbers of features or potentially the on-demand construction of relevant features, in both numerically efficient and theoretically understood ways. Thus, one could get the benefits of very large numbers of features—e.g., better predictive performance—in a reasonable running time.

This problem will be attacked through the tools of regularization by sparsity-inducing norms, that have recently led to theoretical and algorithmic advances, as well as practical successes, in unstructured domains. The scientific objective is thus to marry structure with sparsity: this is particularly challenging because structure may occur in various ways (discrete, continuous or mixed) and the targeted applications in computer vision and audio processing lead to large-scale convex optimization problems.

### 7.3. International Initiatives

#### 7.3.1. INRIA Associate Teams

**7.3.1.1. STATWEB**

Title: Fast Statistical Analysis of Web Data via Sparse Learning

INRIA principal investigator: Francis Bach

International Partner:

- Institution: University of California Berkeley (United States)
- Laboratory: EECS and I EOR Departments

Duration: 2011 - 2013

See also: [http://www.di.ens.fr/~fbach/statweb.html](http://www.di.ens.fr/~fbach/statweb.html)

The goal of the proposed research is to provide web-based tools for the analysis and visualization of large corpora of text documents, with a focus on databases of news articles. We intend to use advanced algorithms, drawing from recent progresses in machine learning and statistics, to allow a user to quickly produce a short summary and associated timeline showing how a certain topic is described in news media. We are also interested in unsupervised learning techniques that allow a user to understand the difference between several different news sources, topics or documents.
7. Partnerships and Cooperations

7.1. International Initiatives

7.1.1. ANR MICROWAVE

Participants: Christophe Besse, Ingrid Lacroix-Violet.

Ch. Besse and I. Lacroix-Violet are members of the new 4-years ANR "blanche" project MICROWAVE. Ch. Besse is the North node coordinator. The scientific subjects deal with artificial boundary conditions for dispersive equations, electromagnetism and high frequency regimes in acoustic simulations. This ANR project concerns the development of new numerical methods for wave propagation problems using tools from microlocal analysis. It focuses on microlocal analysis and numerical methods for acoustic and electromagnetic wave scattering and microlocal analysis and numerical methods for Schrödinger-type equations.

7.1.2. ANR IODISSEE

Participants: Christophe Besse, Pauline Lafitte, Chang Yang.

Ch. Besse has obtained a 4-years ANR grant, from the Cosinus proposal, for the project IODISSEE. P. Lafitte and C. Yang, also members of the EPI Simpaf, are involved in this project. The project IODISSEE also involves a team of mathematicians from Toulouse, a physicist team from Versailles and the Thales group. It deals with the elaboration of a physical model for helping the industrial partner for the new generation of Galileo satellites. For the last decade, satellite positioning devices became one of the most interesting means of navigation for the displacement of the goods and the people. The only current solution is based on the constellation of satellites Navstar GPS American system. Originally developed for military applications, its use was released under the Clinton administration. However, in order to guarantee its autonomy, Europe decided to launch a competitor program known as Galileo. Galileo system differs from the GPS thanks to its capability to provide real time integrity information to the user. In order to guarantee the stability of this system, it is fundamental to take into account the various problems which can affect the mission and to identify all the potential sources of system unavailability. One of the main source of data unavailability that has been identified is the phenomena of ionospheric scintillations. Indeed scintillation causes radio frequency signal amplitude fades and phase variations as satellite signals pass through the ionosphere. Such effects may induce loss of lock or cycle slips on ranging signals broadcast by Galileo satellites making them totally useless for accurate integrity information determination. Scintillations are clearly identified like a source of disturbances. They appear as the turbulent aspect of a larger disturbance of the ionospheric plasma density which have the shape of a plasma bubble. The difficulty of their modeling is due to the lacks of in situ measurements with regard to them. However, some measurements recently acquired during the mission of satellite DEMETER make possible on the one hand the validation of the models existing but also, using techniques of data-models coupling, to reinforce them. The object of this proposal is therefore to provide a physical model making it possible to anticipate the attenuation of the signals during their propagation within the disturbed Earth ionosphere.

7.1.3. ANR MEGAS

Participant: Mathias Rousset.

M. Rousset is involved in the ANR MEGAS. The main scientific subject is numerical methods in Molecular Dynamics simulation.

7.1.4. ANR INTOCS

Participants: Pauline Lafitte, Jean-François Coulombel, Frédéric Lagoutière.
J.-F. Coulombel has obtained a 4-years ANR grant "young researcher", for the project INTOCS. In addition to the coordinator, two other members of the EPI SIMPAF are involved in this project: P. Lafitte et F. Lagoutière. The main scientific subject of the project is the interaction of compressible waves, and more precisely the propagation of high frequency oscillations in hyperbolic boundary value problems. One of the physical motivations is the "Mach stems" formation in reacting gas flows.

7.1.5. AEN Fusion
Participants: Christophe Besse, Thierry Goudon.

SIMPAF is involved in the project led by E. Sonnendrucker from EPI Calvi, which aims at fostering the national research effort in mathematics and computer science towards the simulation of large magnetic confinement devices, like ITER. The project Fusion is currently under evaluation.

7.1.6. COADVISE European Project PEOPLE/IRSES
Participants: Christophe Besse, Caterina Calgaro, Olivier Goubet, Thierry Goudon, Jean-Paul Chehab.

In 2006, under an initiative of J.-P. Chehab, the SIMPAF team has initiated a collaborating program “3+3 Méditerranée” funded by INRIA. This program, devoted to Modelling, Analysis and Simulation of Hydrodynamic Waves, is the continuation of the MASOH project. To be more specific, the project focuses on water waves modelled by dispersive PDEs (Korteweg-De Vries, Benjamin-Ono, KP and Nonlinear Schrödinger equations). The goal is to elaborate efficient multilevel numerical schemes that will be able to help in the understanding of finite time blow up or the asymptotic smoothing effects due to damping. As a consequence, four PhD theses were started co-advised by SIMPAF’s members.

Emna Ezzoug, from Monastir, advised by E. Zahrouni, J. Laminie and O. Goubet, started in July 2006;
Ibtissem Damergi, from Monastir, by advised E. Zahrouni, Ch. Besse and O. Goubet, started in July 2006;
Salim Amr Salim Djahir, from Marrakesh, advised by M. Abounouh and J.-P. Chehab, started in January 2007;

7.1.7. ARC DISCO
Participant: Antoine Gloria.

A. Gloria is the leader of the ARC project DISCO. The main objective is the design, mathematical analysis, numerical analysis, and numerical simulation of discrete models for rubber. The participants are F. Lequeux (polymer physics, ESPCI), P. Le Tallec (mechanics, Ecole polytechnique), F. Otto (mathematics, MPI Leipzig), M. Vidrascu (scientific computing, INRIA Paris-Rocquencourt), and M. de Buhan (postdoc until September 2011). A workshop was organized in January 2011.

7.1.8. ANR AMAM
Participant: Antoine Gloria.

A. Gloria is involved in the 4-year ANR project “young researcher” AMAM, led by V. Millot (Paris 7). The aim of the project is to develop mathematical tools for the analysis of multiscale problems in material sciences (PDEs and variational methods). The fields of interest are primarily micromagnetics, dislocations, fatigue in nonlinear elasticity, and homogenization.

7.1.9. Project CNRS-DGRSRT N° 22640
Participant: Caterina Calgaro.

The main goal of the project is the mathematical analysis and the simulation of miscible or immiscible fluids. In this context, C. Calgaro visited the University of Monastir (Tunisia). As a consequence, one PhD thesis started in october 2010 : Meriem Ezzoug, from Tunis, advised by E. Zahrouni and C. Calgaro.
7. Partnerships and Cooperations

7.1. International Initiatives

7.1.1. INRIA International Partners

Scientific collaboration with the Lavrentyev Institute of Hydrodynamics in Russia.
8. Partnerships and Cooperations

8.1. Regional Initiatives

- **JASMIN** – 2010-2012 (205 kEur). DRIRE programme FEDER. Participants: CADLM, Intercim, TAO (Michèle Sebag).
- **CSDL** – 2009-2012 (290 kEur). FUI System@tic (Région Ile de France grant). Complex System Design Lab Participants: Anne Auger, Nikolaus Hansen, Ilya Loshchilov, Raymond Ros, Marc Schoenauer.

8.2. National Initiatives

- **OMD2** – 2009-2012 (131 kEur). *Optimisation Multi-Disciplinaire Distribuée*, ANR programme COSINUS Coordinator Maryan Sidorkiewicz, RENAULT Technocentre; Participants: Anne Auger, Yohei Akimoto, Nikolaus Hansen, Marc Schoenauer, Olivier Teytaud.
- **SyDiNMaLaS** – 2009-2012 (158 kEur). *Integrating Symbolic Discovery with Numerical Machine Learning for Autonomous Swarm Control*, ANR programme BLANC Coordinator Michèle Sebag, CNRS; Participants: David Meunier, Marc Schoenauer, Michèle Sebag.
- **ASAP** – 2009-2012 (178 kEur). *Apprentissage Statistique par une Architecture Profonde*, ANR programme DEFIS 2009 Coordinator Alain Rakotomamonjy, LITIS, Université de Rouen, France; Participants: Sylvain Chevallier, Hélène Paugam-Moisy, Sébastien Rebecchi, Michèle Sebag.
- **IOMCA** 2010-2013 (264 kEur). Including Ontologies in Monte-Carlo Tree Search and Applications, ANR international project coordinated by O. Teytaud (Tao, INRIA). Participants: Adrien Couëtoux, O. Teytaud.
- **EXPLORA** 2010-2012 (289 kEur, to be shared with Inria Lille). EXPLOitation pour l’Allocation efficace de Ressources. Applications l’optimisation. ANR Project coordinated by R. Munos (INRIA Lille). Participants: David Auger, Olivier Teytaud.
- **SIMINOLE** 2010-2014 (1180k, 250k for TAO). Large-scale simulation-based probabilistic inference, optimization, and discriminative learning with applications in experimental physics, ANR project, Coordinator B. Kégl (CNRS LAL). Participants: Balázs Kégl, Rémi Bardenet, Nikolaus Hansen, Michèle Sebag, Cécile Germain.
8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. SYMBRION

Title: Symbiotic Evolutionary Robots Organisms  
Type: COOPERATION (ICT)  
Defi: Embedded systems design  
Instrument: Integrated Project (IP)  
Duration: February 2008 - January 2013  
Coordinator: Universität Stuttgart (Germany)  
Others partners: Vereniging voor christelijk hoger onderwijs, wetenschappelijk onderzoek en patiëntenzorg, Netherlands; Universität Graz, Austria; Universität Karlsruhe, Germany; Vlaams Interuniversitair Instituut Voor biotechnologie VZW, Blegium; University of the West of England, Bristol, United Kingdom; Eberhard Karls Universität Tübingen, Germany; University of York, United Kingdom; Université libre de Bruxelles, Belgium; INRIA, France.
See also: http://symbrion.eu

8.3.1.2. MASH

Title: Massive Sets of Heuristics For Machine Learning  
Type: COOPERATION (ICT)  
Defi: Cognitive Systems and Robotics  
Instrument: Specific Targeted Research Project (STREP)  
Duration: December 2010 - December 2012  
Coordinator: IDIAP Research Institute (Switzerland)  
Others partners: Centre National de la Recherche Scientifique, France; Weierstrass-Institut fur Angewandte Analysis Und Stochastik, Part of Forschungsverbund Berlin E.V, Germany; INRIA, France; Ceske Vysoke Uceni Technicke V Praze, Czech Republic.
See also: http://mash-project.eu/

8.3.1.3. CITINES

Title: Design of a decision support tool for sustainable, reliable and cost-effective energy strategies in cities and industrial complexes  
Type: COOPERATION (ICT)  
Defi: Smart Cities and Communities  
Instrument: Specific Targeted Research Project (STREP)  
Duration: October 2011 - March 2014  
Coordinator: Artelys SA (France)  
Others partners: Austrian Institute of Technology, Austria; INESC Porto, Portugal; ARMINES (CMA), France; SCHNEIDER ELECTRIC, France; City of Cesena, Italy; City of Bologna, Italy; Tupras - Turkish Petroleum Refineries Corporation, Turkey; ERVET, Italy; INRIA, France.
See also: Artelys Web site

8.4. Contracts managed by CNRS or Paris-Sud University

• EGI FP7 Infrastructure - 2010-2013 (48 kEur) Participants: Cécile Germain, Michèle Sebag, Davy Feng, Julien Nauroy

• Grille Paris-Sud MRM (Moyens de Recherche Mutualisés) 2010-2011 (23KE). Coordinator Balázs Kégl Participants: Cécile Germain, Michèle Sebag, Xiangliang Zhang, Julien Perez, Davy Feng, Julien Nauroy.

• DIGIBRAIN – 2007-2011(48 kEur). DIGITEO grant, coordinator Jean-Denis Muller CEA LIST, France Participants: Cédric Gouy-Pailler, Michèle Sebag.

• Unsupervised-Brain – 2011-2014(5 kEur). DIGITEO grant, coordinator Michèle Sebag LRI Université Paris Sud, France Participants: Yoann Isaac, Cédric Gouy-Pailler, Michèle Sebag.

• MetaModel – 2008-2011 (150 kEur). Advanced methodologies for modeling interdependent systems - applications in experimental physics, ANR “jeune chercheur” grant, coordinator Balázs Kégl Participants: Michèle Sebag, Cécile Germain, Robert Busa-Fekete

8.5. International Initiatives

8.5.1. INRIA International Partners

• NUTN (National University of Tainan, Taiwan). Collaboration of Olivier Teytaud around MoGo (see Invitation section below).

• University of Iceland. Prof. Thomas Philip Runarsson was invited for one month in TAO (October 2011) to work on bandit-based choice of heuristics in combinatorial optimization [57].

8.5.2. Visits of International Scientists

8.5.2.1. Invitations

• Olivier Teytaud (CR1) is invited researcher in NUTN (National University of Tainan, Taiwan) for one year.

• Adrien Couëtoux (Ph.D. student) is in internship in NUTN (National University of Tainan, Taiwan) for 6 months.

• Jérémie Decock (Ph.D. student) will go to NUTN (National University of Tainan, Taiwan) for 5 months.

• Jean-Baptiste Hoock (Ph.D. student) has spent 12 days in Univ. Potsdam (October 2011) for the Mash project.
8. Partnerships and Cooperations

8.1. National Initiatives

- N. Champagnat is a member of the ANR MANEGE and MODECOL (see Section 7.1.1).
- S. Herrmann, D. Talay and E. Tanré are members of the ANR MANDy (see Section 7.1.1).
- P.-E. Jabin is member of the ANR MONUMENTALG (see Section 7.1.1).
- A. Lejay is a member of the ANR ECRU and SIMUDMRI (see Section 7.1.1).
- D. Talay is the Vice-President of the Fondation d’Entreprise Natixis which aims to contribute to develop research in quantitative finance.
  He also serves as a member of the Scientific Committee of the Foundation, jointly with M. Crouhy (Président, Natixis), N. El Karoui (École Polytechnique), R. Gibson (Université de Genève), P.-L. Lions (Collège de France), J.-P. Laurent (Université Claude Bernard, Lyon).
- D. Talay is a member of the Scientific Committee of the AMIES Agency aimed to promote interactions between Mathematics and Industry.

8.2. European Initiatives

8.2.1. Collaborations in FP7 Programs


8.3. International Initiatives

8.3.1. INRIA Associate Teams

8.3.1.1. ANESTOC

Title: Stochastic modelling of renewable energies
INRIA principal investigator: Denis Talay
International Partner:
  Institution: Pontificia Universidad Catolica de Chile (Chile)
  Laboratory: ANESTOC
Duration: 2011 - 2013
See also: [http://www.anestoc.cl/es/?page_id=1112](http://www.anestoc.cl/es/?page_id=1112)

This associate team complements a CIRIC research program in Chile. We refer to the TOSCA-ANESTOC project on stochastic modelling of renewable energies, especially wind farms, and oceanic resources. Our associate team ("Équipe associée Inria") will conduct its joint research at two different levels. Firstly, the mathematical work on its own which we have called the "Mathematical Kernel" (MK), motivated by a number of fundamental problems raised by the specific applications in which we are interested. The second level of research concerns two main axes of Applications: (A1) Applications to Engineering (Renewable energies) and (A2) Applications to Neuroscience. The Mathematical Kernel includes a number of fields in the domains of Stochastic Analysis, Statistics and Numerical Analysis. In particular, it is worth mentioning the following: 1. Probabilistic resolution of Boussinesq non-linear partial differential equations; 2. Stochastic approach to Pope’s equations on
wind dynamics; 3. Open system dynamics as a bridge between Molecular Dynamics and Stochastic Differential Equations; 4. Inference on Stochastic Processes; 5. Algorithms and simulation. The Applications include the stochastic modelling of renewable energy through ocean resources and wind farms (CIRIC-subproject). This subject will be developed with engineers of the Catholic University of Chile. In addition, applications to ion-channel dynamics through cell membranes will be considered jointly with biophysicists of the CINV (Neuroscience Centre of Valparaiso).

8.3.2. INRIA International Partners

- TOSCA participates to the NCCR FINRISK (Financial Risk) forum launched by the Swiss National Science Foundation and managed by the University of Zürich.

8.3.3. Visits of International Scientists

8.3.3.1. Visits of Professors and Researchers

- P. Carmona (Princeton University) has been visiting the team for three days in March.
- M. Cissé (ENSAE, St. Louis, Sénégal) has been visiting the team six weeks in September and October.
- J. Fontbona (Univ. de Chile) has been visiting the team twice three days in May and June.
- J.-F. Jabir (Univ. Toulouse) has been visiting the team three months between April and July, and one week in October.
- L. Lindholm (KTH Royal Institute of Technology, Sweden) has been visiting the team three weeks in August and September.
- A. Rousseau (MERE team, INRIA Sophia – Antipolis, Montpellier) has been visiting the team for two days in January.
- The TOSCA seminar organized by N. Champagnat and J. Charrier in Sophia Antipolis has received the following speakers: Viet Chi Tran (Université des Sciences et Technologies Lille 1), Martin Riedler (Heriot-Watt University Edimbourg, UK), Arturo Kohatsu-Higa (Osaka University, Japan), Dan Crisan (Imperial College, UK), Laurent Miclo (Université Paul Sabatier Toulouse), Sylvain Maire (Université du Sud Toulon – Var), Thomas Önskog (Umea University, Sweden), Denis Villemonais (Ecole Polytechnique, Palaiseau), Gérard Ben Arous (Courant Institute, New York University), Joaquin Fontbona (Universidad de Chile), Jun Yu (Ecole Polytechnique, Palaiseau), Julia Charrier (INRIA Sophia Antipolis – Méditerranée).

8.3.3.2. Internships

Omar Abbes
Subject: Stochastic approaches for wave modelling
Institution: Ecole Polytechnique de Tunisie (Tunisia)

Amine Chourou
Subject: Stochastic volatility models - new numerical methods
Institution: Ecole Polytechnique de Tunisie (Tunisia)

Jun Xu
Subject: Bank networks systemic risk propagation models
Institution: Ecole Polytechnique

Mauricio Tejo
Subject: Mean Field behaviour of ionic channel in neuroscience
Institution: Pontifical Universidad Catolica (Chile)

8.3.4. Participation In International Programs

- P.-E. Jabin is member of the KiNet network, NSF Focus Research Group grant on kinetic description of multi-scale phenomena (as co P.I., main P.I.: E. Tadmor)
- D. Talay is the international coordinator of the MathAmsud program 08MATH05 - Stochastic Analysis and Mathematical Physics Research Network which started in 2009, and also involves M. Bossy, A. Lejay and E. Tanrè.
7. Partnerships and Cooperations

7.1. International Initiatives

7.1.1. Visits of International Scientists

Trond Steihaug, professor at the University of Bergen, is spending a sabbatical period inside Tropics, from September 2011 to May 2012. He was driven to AD by his works on Truncated Newton methods.
6. Partnerships and Cooperations

6.1. European Initiatives

6.1.1. FP7 Project

6.1.1.1. CG-Learning

Title: Computational Geometric Learning (CGL)
Type: COOPERATION (ICT)
Defi: FET Open
Instrument: Specific Targeted Research Project (STREP)
Duration: November 2010 - October 2013
Coordinator: Friedrich-Schiller-Universität Jena (Germany)
Others partners: Jena Univ. (coord.), INRIA (Geometrica Sophia, Geometrica Saclay, ABS), Tech. Univ. of Dortmund, Tel Aviv Univ., Nat. Univ. of Athens, Univ. of Groningen, ETH Zürich, Freie Univ. Berlin.
See also: http://cglearning.eu/

Abstract: The Computational Geometric Learning project aims at extending the success story of geometric algorithms with guarantees to high-dimensions. This is not a straightforward task. For many problems, no efficient algorithms exist that compute the exact solution in high dimensions. This behavior is commonly called the curse of dimensionality. We try to address the curse of dimensionality by focusing on inherent structure in the data like sparsity or low intrinsic dimension, and by resorting to fast approximation algorithms.

6.2. International Initiatives

6.2.1. Visits of International Scientists

6.2.1.1. Internships

Shah Pararth (from May 2011 until July 2011)
Subject: Geometric optimization algorithms for collections of balls.
Institution: IIT Bombay (India)

Deepankar Reddy (from May 2011 until July 2011)
Subject: On relaxation techniques for the maximum clique problem.
Institution: IIT Bombay (India)
6. Partnerships and Cooperations

6.1. Regional Initiatives

6.1.1. Digiteo

**Participants:** Alain Denise, Daria Iakovishina, Feng Lou, Loïc Paulevé, Mireille Régnier, Jean-Marc Steyaert.

P. Clote (Boston College) is a DIGITEO chair. The project deals with RNA properties, with a focus on folding energy distributions and the identification of riboswitches.

6.2. National Initiatives

6.2.1. ANR

**AMIS-ARN, ANR BLANC 2009-2012: Graph Algorithms and Automatic Softwares for Interactive RNA Structure Modelling.** This project is being coordinated by AMIB. The two other involved groups are from PRISM (Versailles University) and E. Westhof’s lab (Strasbourg University). We aim to do substantial progress in the problem of automatically or semi-automatically modelling the three-dimensional structure of RNA molecules, given their sequence. By *semi-automatically* we mean developing algorithms and software that can automatically propose (good) solutions, and that can efficiently compute alternative solutions according to some new constraints or some new hypotheses given by the expert modeler. More precisely, we plan to work on the three following points:

1. Development of computational methods for solving some key steps necessary for modelling RNA 3D structures. These methods will rely on new graph algorithms for molecular structures and on biological expertise on sequence-structure relations in RNA molecules.
2. Implementation of these methods in a software suite, PARADISE, which is being developed by one of the partners (E. Westhof’s lab, Strasbourg University) and which will be made freely available to the scientific community.
3. Application of these methods in order to model several molecules of interest.

**ANR-MAGNUM, ANR BLANC 2010-2014: Algorithmic methods for the non-uniform random generation: Models and applications.** The central theme of the MAGNUM project is the elaboration of complex discrete models that are of broad applicability in several areas of computer science. A major motivation for the development of such models is the design and analysis of efficient algorithms dedicated to simulation of large discrete systems and random generation of large combinatorial structures. Another important motivation is to revisit the area of average-case complexity theory under the angle of realistic data models. The project proposes to develop the general theory of complex discrete models, devise new algorithms for random generation and simulation, as well as bridge the gap between theoretical analyses and practically meaningful data models. The sophisticated methods developed during the past decades make it possible to enumerate and quantify parameters of a large variety of combinatorial models, including trees, graphs, words and languages, permutations, etc. However these methods are mostly targeted at the analysis of uniform models, where, typically, all words (or graphs or trees) are taken with equal likelihood. The MAGNUM project proposes to depart from this uniformity assumption and develop new classes of models that bear a fair relevance to real-life data, while being, at the same time, still mathematically tractable. Such models are the ones most likely to be connected with efficient algorithms and data structures.
6.2.2. Inria-Inra

AMIB and INRA-TOURS (A. Poupon) are partners in a two years project ASAM. This project aims to help the understanding of signalling pathways involving G protein-coupled receptors (GPCR) which are excellent targets in paramacogenomics research. Large amounts of experiments are available in this context while globally interpreting all the experimental data remains a very challenging task for biologists. The aim of ASAM is thus to provide means to semi automatically construct signalling networks of GPCRs. In particular, ASAM aims to base its solution on the design of a knowledge base containing expert rules able to interpret various experimental results and semi automatically construct signalling networks. Interestingly, each piece of the network (a piece of data or a relationship between pieces of data) may be associated with quality information depending on various criteria (a piece of data obtained by various experiments or by experiments of high quality etc.).

6.3. International Initiatives

6.3.1. INRIA Associate Teams

6.3.1.1. GNAPI

Title: Geometric and knowledge-based analysis for Nucleic Acid and Protein dynamics and Interactions
INRIA principal investigator: JulieBernauer
International Partner:
   Institution: Stanford University School of Medicine (United States)
   Laboratory: Computational Structural Biology
Duration: 2009 - 2011
See also: http://www.lix.polytechnique.fr/~bernauer/EA_GNAPI/

Many biological processes of therapeutic interest, such as gene regulation, involve RNA molecules and their interactions with large protein assemblies. Recent high-throughput experiments have yielded insights into mechanisms of these processes but often structural models showing important structural features and interactions are lacking. Using 3D data available for proteins and RNA, we derived knowledge-based potentials to predict protein and nucleic-acid 3D structure. In combination with appropriate geometric representations, we obtained fast and accurate all-atom and coarse-grained predictions of biomolecular structures. We show that we can accurately build knowledge-based potentials from various all-atom and coarse-grained measures. Using this method and an encoding of multi-body contacts through arrangement of circles on a sphere, we obtained a reasonable model of protein structure. We also applied this strategy to assess RNA structures and showed that it is currently one of the best performing potentials for RNA structure evaluation. These results suggest that our knowledge-based models may also be suitable for the study of RNA dynamics and interactions.

6.3.2. Visits of International Scientists

6.3.2.1. Invited researchers (long stays)

Peter Clote
   Subject: Digiteo chair
   Institution: Boston College (United States of America)

6.3.2.2. Invited researchers (Short stays)

Artem Kasyanov, (IOGene, Moscow), 2 weeks;
Institution: IOGene (Russia (Russian Federation))

M. Levitt, 3 days
        Institution: Stanford University (USA)

A. Sim(Stanford), 10 days;
        Institution: Stanford University (USA)

6.3.2.3. Internship

Leonid Uroshlev
        Subject: Study of reference states for the building of RNA knowledge-based potentials
        Institution: Laboratoire Franco-Russe Poncelet (Russia (Russian Federation))

Angela Yen
        Subject: A dynamic-programming extension of MC-Fold applicable to Boltzmann equilibrium applications.
        Institution: MIT (United States of America)

Anindya Jyoti Roy
        Subject: Development of new support vector machines techniques for the analysis of RNA motifs
        Institution: IIT Kanpur

6.3.3. Participation In International Programs

Exists a long term collaboration between AMIB and IOGENE, previously NIIGENETIKA, through Liapunov Institute, former MIGEC associate team and Poncelet Institute.
7. Partnerships and Cooperations

7.1. Regional Initiatives

- G. Dumont is partly supported for his PhD thesis by a grant from region Aquitaine and partly from scholarship of CNRS.
- S. Labarthe is partly supported for his PhD thesis by a grant from region Aquitaine.

7.2. National Initiatives

M. Langlais, B. Aïnseba and A. Noussair were members of the proposal ADHOC 2010, Co-viability modeling of fisheries and marine biodiversity, funded in 2009 by ANR “La 6me extinction” with L. Doyen as principal investigator.

7.3. European Initiatives

7.3.1. Major European Organizations with which you have followed Collaborations

There exists a long collaboration with A. Ramos, head of the department of applied mathematics at the complutense university of Madrid on the theory of factorization of boundary value problems.

The same long term collaboration exists with B. Louro at the new university of Lisbon with whom J. Henry is co supervising the thesis of M. Orey.

7.4. International Initiatives

7.4.1. Visits of International Scientists

The team invited Pr Tayeb Benouaz from Tlemcen university in december 2011. Pr A.M. Ramos was invited in March 2011.

7.4.2. Participation In International Programs

- J.B. Burie, A. Ducrot and M. Langlais won an Orchid collaboration program for 2010-11 on “Singular reaction-diffusion systems and persistence phenomena” with Guo Jong-Shenq, Fu Sheng Chen, Tsai Je-Chiang and Wu Chin-Chin at the National Taiwan Normal University.
- J. Henry and O. Tarniceriu have a collaboration within the French-Romanian initiative LEA lead by CNRS.
7. Partnerships and Cooperations

7.1. National initiatives

7.1.1. ANR KaraMetria

Participants: Xavier Pennec [correspondant], Vikash Gupta, Marco Lorenzi.

KaraMetria is the concatenation of Kara ("head", "brain" in ancient Greek), and Metria ("measure"). This ANR-funded project (2010-2012, http://sites.google.com/site/karametria/) aims at: developing an extensible image registration framework able to map anatomical descriptors (such as sulcal lines or white matter fibers) of the brain shape from one subject to another; providing all necessary statistical tools to compare a subject with a group or compare groups of subjects based on the aforementioned registration framework; and identifying biomarkers of certain brain pathologies and psychiatric disorders. In particular, we target the study of a population of depressive teenagers. This project is led in collaboration with the LNAO at CEA, the MAP5 laboratory from the University Paris Descartes, and the INSERM U797 unit.

7.1.2. INRIA Cooperative Research Initiative SIRAP

Participants: Maxime Sermesant [correspondant], Xavier Pennec, Tommaso Mansi, Kristin McLeod.

The aim of this Collaborative Research Initiative is to develop physiological and statistical models of the right ventricular outflow tract of repaired Tetralogy of Fallot patients in order to help the design and implant of valves. This action is led by Jean-Frederic Gerbeau from the REO team, INRIA Rocquencourt. It is in collaboration with the pediatric cardiologist Younes Boudjemline, Necker Hospital, Paris.

7.1.3. Consulting for Industry

- Nicholas Ayache is scientific consultant for the company Mauna Kea Technologies (Paris).
- Grégoire Malandain is a member of the technical council of the company Dosisoft (Paris), a subsidiary from the Gustave Roussy Institute and the Curie Institute (Paris).

7.1.4. Collaboration with national hospitals

Here we provide a list of research centers in national hospitals with whom we collaborate in common research projects.

7.1.4.1. IRCAD, hôpitaux de Strasbourg

Pr. Marescaux and L. Soler: hepatic surgery simulation segmentation of abdominal structures from CT scan images and augmented reality for guidance in hepatic surgery [111], [112].

7.1.4.2. CHU de Nice, Hôpital Pasteur

We continue our collaboration with Dr. C. Lebrun-Frenay of the neurology department, and with Dr. Chanalet of the radiology department, within the framework of a study on the temporal evolution of MS lesion load.

7.1.4.3. CHU de Nice, Hôpital L’Archet

We continue our collaboration with Pr. Dellamonica and Dr. Vassallo of the infectiology department on the study of cognitive impairment in HIV patients.

7.1.4.4. CHU de Bordeaux

We have initiated a collaboration with Pr. Michel Haïssaguere and Pr Pierre Jais on the modeling of cardiac electrophysiology and arrhythmias.
7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. EUHEART

Participants: Hervé Delingette [Correspondant], Nicholas Ayache, Adityo Prakosa, Ken C.L. Wong, Federico Spadoni, Jatin Relan, Stéphanie Marchesseau, Maxime Sermesant.

Title: euHeart
Type: COOPERATION (ICT)
Defi: Virtual Physiological Man
Instrument: Integrated Project (IP)
Duration: June 2008 - May 2012
Coordinator: Philips Technologie GmbH Forschungslaboratorien (Germany)
Others partners: Philips Technologie GmbH (DE), The University of Oxford (UK), Universitat Pompeu Fabra (SP), The University of Sheffield (UK), INRIA, French National Research Institute in Informatics and Mathematics (FR), King’s College London (UK), Academisch Medisch Centrum bij de Universiteit van Amsterdam (NL), Universität Karlsruhe (TH) (DE), Institut National de la Santé et de la Recherche Médicale, INSERM (FR), Philips Medical Systems Nederland BV (NL), Berlin Heart GmbH (DE), HemoLab BV (NL), Universitätsklinikum Heidelberg (DE), Volcano Europe SA / NV (BE), Hospital Clínico San Carlos de Madrid (SP), Philips Ibérica S.A. (SP)
See also: http://www.euheart.eu/

Abstract: The euHeart project (Ref 224495), is a 4-year integrated European project which aims at developing personalized, and clinically validated multi-physics, multi-level models of the heart and great vessels. Those models need to be tightly integrated with signal and image processing tools in order to assist clinical decision making and to help reducing morbidity and mortality rates associated with cardiovascular diseases. Asclepios is leading a workpackage on radiofrequency ablation for which electromechanical models of the heart are used to improve the planning of radiofrequency ablation lines for patient suffering from atrial fibrillation and ventricular tachycardia. The research performed in this project is partially described in section 5.4.4 and 5.4.5

7.2.1.2. PASSPORT

Participant: Hervé Delingette [Correspondant].

Title: PASSPORT
Type: COOPERATION (ICT)
Defi: Virtual Physiological Man
Instrument: Specific Targeted Research Project (STREP)
Duration: June 2008 - November 2011
Coordinator: IRCAD, (France)
Others partners: IRCAD (FR), ETHZ (CH), TUM (DE), UCL (UK), ICL (UK), IZBI (DE), INSERM (FR), Storz (DE), U, Strasbourg (FR)
See also: http://www.passport-liver.eu

Abstract: The PASSPORT project (Ref 223894) is a 3-year STREPS European project which aims at developing patient-specific models of the liver. Those models should integrate anatomical, functional, mechanical, appearance, and biological descriptions of the liver. INRIA is involved in this project through the teams Alcove, Shacra and Asclepios and around the software platform SOFA which serves as the integration platform for the project.
7.2.1.3. VPH NOE

Participants: Benoît Bleuzé [correspondant], Olivier Clatz, Maxime Sermesant, Nicholas Ayache.

Type: COOPERATION (ICT)
Defi: Virtual Physiological Man
Instrument: Network of Excellence (NoE)
Duration: June 2008 - November 2012
Coordinator: University College London, UK
Others partners: Core members include UCL (UK), Oxford (UK), CNRS (FR), ULB (BE), U. of Nottingham (UK), UPF (ES), U. Auckland (NZ), EMBL (DE), U. Sheffield (UK), Karolinka (SE), ERCIM (FR), IOR (IT).

See also: http://www.vph-noe.eu/

Abstract: The Virtual Physiological Human Network of Excellence (VPH NoE) is a EU seventh Framework funded project, working to connect and support researchers in the VPH field within Europe and beyond. INRIA is one of the core members, and is more dedicated, through Asclepios, to the data fusion part of the VPH toolkit. More precisely, a registration toolbox has been delivered which aims at including registration algorithms from the team and elsewhere into the new version of MedINRIA 2.x.

7.2.2. Collaborations in European Programs, except FP7

7.2.2.1. Care4Me

Participants: Grégoire Malandain [Correspondant], Nicholas Ayache, Hervé Delingette, Xavier Pennec, Kristin McLeod, Erin Stretton, Maxime Sermesant.

Program: ITEA2
Project acronym: Care4Me
Project title: Cooperative Advanced REsearch for Medical Efficiency
Duration: Sept. 2009 - Sept. 2013
Coordinator: Philips, NL.

Other partners: Alma (ES), Bull (FR), CEA (FR), CIMNE (ES), Compasiss (ES), CVSS (ES), Duodecim (FI), Erasmus MC (NL), ESI (NL), HSP (ES), Helsinki Hosp. (FI), ISI (GGR), LUMC (NL), MediConsult (FI), MEDIS (NL), Nokia (FI), Philips (NL), Pie Medical Imag. (NL), Pohjola (FI), Prowellness (FI), Robotiker (ES), UMC (NL), VTT (FI)

Abstract: This project aims at increasing quality and productivity in the healthcare care cycle by using more advanced medical imaging and decision support methods while combining them with different knowledge sources, from early diagnosis to treatment and monitoring. The final outcome of this project are clinical prototypes of novel medical image analysis and decision support systems for three specific disease areas (cancer, cardio-vascular and neurodegenerative diseases), that connect to the hospital information systems using a new system architecture. In this project, the role of the Asclepios team is to develop atlas of the ageing brain and the beating heart, and to model tumor growth.
7.3. International Initiatives

7.3.1. INRIA Associate Teams

7.3.1.1. CAPNEONATES

Title: Analysis of structural MR and DTI in neonates
INRIA principal investigator: Pierre Fillard [Parietal]
Asclepios investigator: Xavier Pennec

International Partner:
Institution: University of Southern California (United States)
Laboratory: Image Lab at Children Hospital at Los Angeles
Researcher: Natasha Leporé

International Partner:
Institution: University of Pennsylvania (United States)
Laboratory: Penn Image Computing and Science Laboratory
Researcher: Caroline Brun

Duration: 2011 - 2013
See also: http://www.capneonates.org/

While survival is possible at increasingly lower gestational ages at birth, premature babies are at higher risk of developing mental disorders or learning disabilities than babies born at term. A precise identification of the developmental differences between premature and control neonates is consequently of utmost importance. Nowadays, the continuously improving quality and availability of MR systems make it possible to precisely determine, characterize and compare brain structures such as cortical regions, or white matter fiber bundles. The objective of this project is to understand the developmental differences of premature versus normal neonates, using structural and diffusion MRI. This work will consist of identifying, characterizing and meticulously studying the brain structures that are different between the two groups. To do so, we propose to join forces between the Parietal team at INRIA and the University of Southern California. Parietal has a recognized expertise in medical image registration and in statistical analyses of groups of individuals. USC has a broad knowledge in MR image processing. In particular, the Children’s Hospital at Los Angeles (CHLA), which is part of USC, is in the process of collecting a unique database of several hundreds of premature and normal neonates MR scans. This joint collaboration is consequently a unique chance of addressing key questions pertaining to neonatal and premature development. It will make it possible to elaborate new tools to analyze neonate MR images while tremendously increasing our knowledge of neuroanatomy at such an early stage in life.

7.3.1.2. COMPUTUMOR

Title: Computational Brain Tumor
INRIA principal investigator: Olivier Clatz

International Partner:
Institution: Massachusetts Institute of Technology (United States)
Laboratory: Computer Science and Artificial Intelligence Laboratory (CSAIL)

International Partner:
Institution: German Cancer Research Center (United States)
The CompuTumor associated team has been funded early 2007 and renewed in 2009. The CompuTumor project is dedicated to the study of brain tumor models and their coupling with medical images to better assist diagnosis and therapy. The project strongly enhance the current collaborations between INRIA and a group of world leading teams with complementary technical and clinical expertise on these topics in Boston and Nice. More specifically, the project aims at (a) proposing new medical image processing method that could be used to better analyze tumor images, (b) developing new brain tumor models in order to personalize these models with patient data. Microsoft Research has been also recently involved in the collaboration on lesion segmentation. Our most recent activity is described in sections 5.1.1 and 5.4.1 and also on the website of the associated team: http://www-sop.inria.fr/asclepios/projects/boston/.

7.3.2. INRIA International Partners

7.3.2.1. Collaboration with international hospitals

7.3.2.1.1. St Thomas’ Hospital, King’s College London, United Kingdom

Maxime Sermesant is a part-time lecturer in the Interdisciplinary Medical Imaging Group, Division of Imaging Sciences, St Thomas’ Hospital, King’s College London lead by Pr Reza Razavi. The XMR facility within this hospital is a unique possibility to validate and exploit the cardiovascular modelling work.

7.3.2.1.2. Children Hospital, Boston

A collaboration with Dr Simon Warfield, director of the Computational Radiology Laboratory has been active for several years, especially on the issue of atlas-based image segmentation and registration.

7.3.2.1.3. Other International Hospitals

Collaborations with several other European hospitals have been established through the European projects Passport and euHeart.

7.3.3. Visits of International Scientists

Christof Seiler was a visiting PhD student from University of Bern for a period of 9 months starting in February 2011.

Stefan Sommer was a visiting student from the Dept. of Computer Science, Univ. Copenhagen, for 6 months during the period 2010-2011.

Stephen Marsland (associate professor at Massey University in Palmerston North, New Zealand) was a visiting scientist for 1 month in Oct-Nov 2011.
7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. CPER TELIUS

Duration: 2007–2013

This grant, funded by regional and National support, covers 3 areas: an experimental platform for research on telecommunication networks, a software and informatics platform (including a virtual reality environment, a medical imaging platform, and a peer-to-peer computing grid), and a experimental platform on the usage of information systems. Athena is being funded through the medical imaging platform, to develop its electroencephalography laboratory.

7.2. National Initiatives

7.2.1. ANR ViMAGINE

Participants: Maureen Clerc, Rachid Deriche, Alexandre Gramfort [Parietal project-team], Emmanuel Olivi, Théodore Papadopoulo, Anne-Charlotte Philippe.

Duration: July 2008 to July 2012

The partners of this project are Athena, the LENA (CHU Pitié-Salpêtrière), and the Parietal project-team at INRIA Futurs and Neurospin-Saclay.

This project takes a new challenge on the non invasive exploration of the Human visual system in vivo. Beyond the basic mechanisms of visual perception – which have already been investigated at multiple scales and through a large variety of modalities – we are primarily interested in proposing and exploring innovative solutions to the investigation of dynamic neural activations and interactions at the systems level. Bridging the elements involved in this endeavour requires that we are capable of observing, modelling and predicting the interplay between the anatomical/functional architecture of the brain systems and some identified timing properties of neural processes. The overall framework in which this project will be conducted is a federation of partners who will be bringing complementary expertise to this multidisciplinary research. The collaborators include experts in (1) electromagnetic and magnetic resonance brain imaging methods, (2) computational models of neural systems and (3) the neuroscience of vision. A central asset of our group is the easy access to state-of-the-art imaging platforms (e.g. high-density MEG and EEG arrays; 3T and 7T MR scanners) that will ensure the acquisition of quality experimental data.

7.2.2. ANR CO-ADAPT

Participants: Maureen Clerc, Dieter Devlaminck, Joan Fruitet, Sebastian Hitziger, Théodore Papadopoulo, Eoin Thomas, Romain Trachel.

Duration: September 2009 to December 2013

The partners of this projects are the INSERM U821 laboratory of Bron, the "laboratoire de Neurologie de la cognition" UMR6155 CNRS of Marseille, The INRIA Lille Sequel project-team and the "Laboratoire d’Analyse Topologie et Probabilités UMR6632/CNRS of Université de Provence, Marseille.

Brain Computer Interfaces (BCI) provide a direct communication channel from the brain to a computer, bypassing traditional interfaces such as keyboard or mouse, and also providing a feedback to the user, through a sensory modality (visual, auditory or haptic). A target application of BCI is to restore mobility or autonomy to severely disabled patients, but more generally BCI opens up many new opportunities for better understanding the brain at work, for enhancing Human Computer Interaction, and for developing new therapies for mental illnesses.
In BCI, new modes of perception and interaction come into play, and a new user must learn to operate a BCI, as an infant learns to explore his/her sensorimotor system. Central to BCI operation are the notions of feedback and of reward, which we believe should hold a more central position in BCI research.

The goal of this project is to study the co-adaptation between a user and a BCI system in the course of training and operation. The quality of the interface will be judged according to several criteria (reliability, learning curve, error correction, bit rate). BCI will be considered under a joint perspective: the user’s and the system’s. From the user’s brain activity, features must be extracted, and translated into commands to drive the BCI system. Feature extraction from data, and classification issues, are very active research topics in BCI. However, additional markers may also be extracted to modulate the system’s behavior. It is for instance possible to monitor the brain’s reaction to the BCI outcome, compared to the user’s expectations. This type of information we refer to as meta-data because it is not directly related to the command, and it may be qualitative rather than quantitative. To our knowledge, there is so far no BCI system that integrates such meta-data from the user’s brain. From the point of view of the system, it is important to devise adaptive learning strategies, because the brain activity is not stable in time. How to adapt the features in the course of BCI operation is a difficult and important topic of research. A Machine Learning method known as Reinforcement Learning (RL) may prove very relevant to address the above questions. Indeed, it is an adaptive learning method that explicitly incorporates a reward signal, which may be qualitative (hence allowing meta-data integration). The aim of CO-ADAPT is to propose new directions for BCI design, by modeling explicitly the co-adaptation taking place between the user and the system (web site http://coadapt.inria.fr).

7.2.3. ANR NucleiPark

**Participants:** Rachid Deriche, Aurobrata Ghosh, Anne-Charlotte Philippe, Emmanuel Caruyer, Jian Cheng, Alvaro-Alejandro Sanchez-Moscosa, Demian Wassermann.

**Duration:** September 2009 to December 2012

This project is about High field MR imaging (7T and 3T) of the brainstem, the deep nuclei and their connections in the parkinsonian syndromes with applications to prognosis, pathophysiology and improvement of therapeutic strategies. It involves three partners: The NeuroSpin team including C. Poupon and D. Le Bihan, the INRIA with our project as well as the VISAGES project-team and the UPMC (University Pierre and Marie Curie, Paris) including INSERM U678 (H. Benali) and the CENIR (S. Lehericy).

The goal of the project is to find new neuroimaging markers of deep brain nuclei in neurodegenerative diseases that can be used for the diagnosis of Parkinsonian syndromes at the early stage. In addition, the goal is the characterization of lesions of deep brain structures and the detection of biomarkers of neuronal lesions in PD that can be related to clinical signs, such as gait disorders. Biomarkers of Parkinsonian syndromes could be used to create a diagnostic tool of the pathology and to correlate the identified markers with clinical signs. We will perform tractography of small fibre bundles using our HARDI techniques and Diffusion markers (anisotropy, apparent diffusion coefficient, fibre density, curvature, average diameter) will be collected along the reconstructed bundles.

Complementary parts of these objectives directly related to the acquisitions protocols have been accepted within the framework of another proposal submitted by the same partners and accepted for grant for two years (2009 & 2010) by the France-Parkinson Association

7.2.4. ANR MULTIMODEL

**Participants:** Théodore Papadopoulo, Maureen Clerc, Sebastian Hitziger.

**Duration:** December 2010 to March 2014

The general objectives of the MULTIMODEL project are twofold:

- Develop computational models at the level of neuronal systems that will help interpreting neuroimaging data in terms of excitation-, inhibition- and synchronization-related processes.
- Acquire multimodal datasets, obtained in rats and humans under physiological and epileptogenic conditions, which will be used to develop the biophysical models and to test their face validity and predictability.
Specifically, during this 3-year project, the following questions will be dealt with:

- How can models be integrated in order to link data from different modalities (electro/magnetoencephalography, optical imaging, functional MRI)?
- What is the influence of hidden parameters on the observed signals (e.g. ratio of excitation/inhibition and synchronization degree across regions)?
- To what extent can biophysical modelling bring valuable insights on physiological and pathological brain activity?

We will operate at the level of population of cell, i.e. at a scale compatible with the resolution of neuroimaging tools (at the level of the mm). A novel model structure will be investigated. It will include astrocytes at this “mesoscopic” level and will operate in networks of connected regions. Moreover, models in physiological and pathological conditions will be compared, which will be a step towards a better understanding of mechanisms underlying epileptic condition.

The MULTIMODEL project stems from a conjoint INSERM-INRIA scientific initiative launched in December 2008 and ended in 2010. It involves 5 partners (Inserm U751 in Marseille, U678 in Paris, U836 in Grenoble, U642 in Rennes and INRIA Athena project-team).

7.2.5. ADT Immersive BCI

**Participants:** Théodore Papadopoulo, Maureen Clerc, Nicolas Servant, Joan Fruitet.

**Duration:** December 2009 to December 2011

The goal of this technical project, funded by INRIA for 2 years, is to facilitate the use of EEG within a new immersive environment at INRIA Sophia Antipolis Méditerranée, in order to make it possible to perform BCI or cognitive experiments within this environment. Using a BCI within an immersive environment will open up new possibilities for scientific research, both in BCI and in Virtual Reality. All development linked to this project will take place within an integrative software platform. This development will include electrode localization and real-time EEG processing with feedback to the user.

7.2.6. ADT MedInria-NT

**Participants:** Théodore Papadopoulo, Maureen Clerc, Rachid Deriche.

**Duration:** December 2010 to December 2012

The goal of this technical project, funded by INRIA for 2 years, is to introduce some tools developed at ODYSSEE/ATHENA into the MedINRIA platform. There are basically two such facilities:

- Integrate the tools developed for the statistical characterization of brain white matter fiber bundles.
- Develop an interface for M/EEG data within MedINRIA. This will focus on two main goals:
  - Create a facility to read and visualize M/EEG signals.
  - Integrate M/EEG forward problem tools.

7.3. International Initiatives

7.3.1. INRIA Associate Teams

7.3.1.1. CDMRI

**Title:** Computational Diffusion MRI

INRIA principal investigator: Rachid Deriche

International Partner:

Institution: University of Minnesota (United States)
Laboratory: Department of Electrical and Computer Engineering at University of Minnesota, Center for Magnetic Resonance Research
Researchers: Guillermo Sapiro & Christophe Lenglet

International Partner:
Institution: National Institute of Child Health and Human Development (Bethesda, MD) (United States)
Laboratory: Section on Tissue Biophysics and Biomimetics
Researcher: Peter Basser

Duration: 2009 - 2011
See also: http://www-sop.inria.fr/teams/odyssee/contracts/Computational-Diffusion-MRI/

The CD-MRI Associate Team was created to bring each partner’s expertise together in the field of Diffusion Magnetic Resonance Imaging with the objective to help in making significant contributions to the processing and analysis of diffusion weighted imaging data, a task well known to be extremely challenging due to the complex underlying properties of the tissue being imaged and the structure of the data.

The rational behind this project was to benefit from the complementarity and the synergy of our expertise and to combine our efforts and ideas to succeed achieving this exciting and challenging objective. Indeed, our groups at Inria, NICHD and the University of Minnesota have great and complementary expertise in Diffusion MRI.

ATHENA Project Team has greatly contributed during the last years to develop original and efficient algorithms relying on Riemannian geometry, differential geometry, partial differential equations and front propagation techniques to correctly and efficiently process Diffusion MRI data. The group of Peter Basser at NICHD had pioneered the so-called diffusion tensor imaging in the mid 90’s, and since then has developed numerous and important applications to clinical research. The Center for Magnetic Resonance Research at University of Minnesota is a research lab, unique in the domain of high field MRI, with no less than six high field magnets; and the group of Guillermo Sapiro in the department of Electrical and Computer Engineering is one of the best worldwide dedicated to research in imaging sciences.

Therefore, the CD-MRI started in 2009 with the following main objectives:

- Develop rigorous mathematical and computational tools for the analysis of Diffusion MRI data.
- Improve acquisition techniques for High Angular Resolution Diffusion Imaging.
- Write joint publications and help address challenging clinical applications.

Through an extensive exchange program involving PhD’s as well Post-Docs’s and senior scientists between all the partners, our Associate Team has been able to tackle these challenging objectives without the need to relocate any of them.

Indeed, we have contributed to advance the state-of-the-art in Computational Diffusion MRI, we have been very successful to initiate and pursue research on optimal diffusion gradient schemes (single, multi-shell), online ODF reconstruction and motion detection, optimal reconstruction of the propagator and decoding axon diameter distribution information encrypted in radial NMR attenuation signals. We proposed new Kalman based acquisition and sampling techniques particularly well adapted to process HARDI data and make it clinically feasible, and wrote several joint publications in international conferences, some of which are or will be submitted to journals.

7.3.2. Visits of International Scientists

7.3.2.1. Internships
John TREILHARD (from May 2011 until Aug 2011)
Subject: Using Radial NMR Profiles to Characterize Pore Size Distributions.
Institution: Queen’s University, Kingston Ontario (Canada).
Supervisor: R. Deriche.

Alvaro Alejandro SANCHEZ MOSCOSA (from April 2011 until Sept. 2011)
Subject: White Matter Clustering Revisited.
Institution: Royal Institute of Technology, KTH STH (Sweden).

Karthikeyan GANESAN (from March 2011 until June 2011)
Subject: Modélisation multimodale de données fonctionnelles cérébrales.
Institution: Delft University of Technology (Netherlands).
Supervisor: T. Papadopoulo and M. Clerc.

Meizhu Liu (from May 2011 until July 2011)
Subject: A Variational based Approach for Diffusion MRI Régularization and its Applications.
Institution: University of Florida (United States).
Supervisor: R. Deriche.

Gonzalo Vegas-Sánchez-Ferrero (from May 2011 until July 2011)
Subject: Anisotropic LMMSE denoising of MRI based on statistitical tissue models
Institution: University of Valladolid (Spain).
Supervisor: R. Deriche.

7.3.3. Participation In International Programs

We have initiated a collaboration entitled Computational Brain Imaging Through Diffusion MRI with the Computer Vision and Pattern Analysis Laboratory led by Pr. Gozde Unal at the Faculty of Engineering and Natural Sciences, Sabanci University, Istanbul (Turkey). Our main objective in this PHC Bosphore 2010 project is focused on automating the tractography process for white matter fibers. Building on the expertise of the two teams at INRIA and Sabanci University (SU), we will develop novel computational techniques for processing Diffusion Tensor-MRI (DTI), and study specific pathways for their analysis and visualization using new mathematical models. This project started in January 2010 and is granted for 2 years.

We have also a collaboration within the framework ECOS-Sud on a project based on Diffusion MRI and Autism with Prof. Mariano Sigman (Integrative Neuroscience Laboratory, Physics Dept. University of Buenos Aires, Buenos Aires, Argentina) and B. Wicker (INCM UMR 6193 CNRS, Université de la Méditerranée, Marseille, France) and O. Coulon (LSIS/ESIL UMR 6168). This project started in Sept. 2009 and is granted for 2 years.

We have also a collaboration within the framework STIC-Algerie on a project based on Diffusion MRI with Prof. D. Cherifi and L. Boumghar from USTHB, Algiers. This project started in July 2011 and is granted for 2 years.
7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. Adaptanthroph
- Title: Adaptation des insectes aux anthroposystèmes
- Coordinator: M. Harry
- BAMBOO participant(s): C. Vieira
- Type: ANR Génoplante (2009-2012)
- Web page: Not available

7.1.2. Alcovna
- Title: ALgorithms for COmparing and Visualzing Non Assembled data
- Coordinator: Pierre Peterlongo
- BAMBOO participant(s): J. Kielbassa, V. Lacroix, G. Sacomoto, M.-F. Sagot
- Type: ARC INRIA (2010-2011)
- Web page: http://alcovna.genouest.org/

7.1.3. AphiCible
- Title: Impact de la recombinaison et de la conversion génique biaisée sur l’évolution de génomes
- Coordinator: Y. Rahbé
- BAMBOO participant(s): Y. Rahbé and H. Charles
- Type: ANR Génoplante (2008-2011)
- Web page: Not available

7.1.4. Cogebi
- Title: Symbiosis, digestion and reproduction as aphid physiological processes to identify new targets for insecticides
- Coordinator: L. Duret (LBBE)
- BAMBOO participant(s): C. Gautier, E. Tannier
- Type: ANR Génomique Animale (2008-2011)
- Web page: Not available

7.1.5. ImmunSymbArt
- Title: Immunity and Symbiosis in Arthropods
- Coordinator: D. Bouchon
- BAMBOO participant(s): F. Vavre
- Type: ANR Blanc (2010-2014)
- Web page: Not available
7.1.6. Metagenomics of Bemisia tabaci

- Title: Metagenomics of *Bemisia tabaci* symbiotic communities
- Coordinator: L. Mouton (LBBE, UCBL)
- BAMBOO participant(s): F. Vavre, M.-F. Sagot
- Type: Genoscope Project
- Web page: none

7.1.7. NeMo

- Title: Network Motifs
- Coordinator: S. Robin (AgroParisTech, Paris)
- BAMBOO participant(s): V. Lacroix, M.-F. Sagot
- Type: ANR Blanc (2008-2011)

7.1.8. MIRI

- Title: Mathematical Investigation of "Relations Intimes"
- Coordinator: M.-F. Sagot
- BAMBOO participant(s): V. Acuña, C. Baudet, C. Gautier, V. Lacroix, P. Milreu, C. Klein, I. Nor, M.-F. Sagot, P. Simões
- Type: ANR Blanc (2009-2012)

7.2. European Initiatives

7.2.1. FP7 Project

7.2.1.1. SISYPHE

- Title: The Microme Project: A Knowledge-Based Bioinformatics Framework for Microbial Pathway Genomics
- Coordinator: P. Kersey (EBI)
- European partners: Amabiotics (France), CEA (France), CERTH (Greece), CSIC (Spain), CNIO (Spain), DSMZ (Germany), EBI (UK), HZI (Germany), Isthmus (France), Molecular Network (Germany), SIB (Switzerland), Tel Aviv Univ. (Israel), Université Libre de Bruxelles (Belgium), WTSI (UK), Wageningen Univ. (The Netherlands)
- BAMBOO participant(s): Anne Morgat
- Type: Collaborative Project. Grant Agreement Number 222886-2
- Web page: [http://www.microme.eu](http://www.microme.eu)

- Title: Species Identity and SYmbiosis Formally and Experimentally explored
- Coordinator: M.-F. Sagot
- BAMBOO participant(s): Whole BAMBOO team
- Type: ERC Advanced Grant (2010-2015)
7.2.2. Collaborations in European Programs, except FP7

7.2.2.1. METNET4SysBio

- Title: System level analysis of animal metabolism by multicompartment graph- and constraint-based modelling
- Coordinator: H. Charles (INSA Lyon, France)
- BAMBOO participant(s): V. Acuña, H. Charles, C. Gautier, V. Lacroix, Y. Rahbé, M.-F. Sagot
- European Partner: Angela Douglas, York University, UK

7.2.2.2. SIMBIOSt

- Title: Mathematical and algorithmic investigation of symbiosis
- Coordinators: M.-F. Sagot (France), A. Marchetti-Spaccamela (Italy), L. Stougie (the Netherlands)
- BAMBOO participant(s): Whole BAMBOO Team
- Type: Associated Team INRIA (2009-2011)

7.2.3. Major European Organizations with which you have followed Collaborations

Partner 1: Pierluigi Crescenzi, Univ. Florence, Italy
Algorithmic (graphs, trees, sequences), complexity

Partner 2: Ana Teresa Freitas, INESC-ID, IST Lisbon, Portugal
NGS, metabolism, small RNAs, motifs

Partner 3: Alberto Marchetti-Spaccamela, Univ. Rome La Sapienza, Italy
Algorithmic (graphs, trees), complexity

Partner 4: Nadia Pisanti and Roberto Grossi, Univ. Pisa, Italy
Algorithmic (graphs, trees, sequences)

Partner 5: Leen Stougie, Free Univ. Amsterdam and CWI, the Netherlands
Algorithmic (graphs, trees), complexity

7.3. International Initiatives

7.3.1. INRIA International Partners: AMICI

- Title: Algorithms and Mathematics for Investigating Communication and Interactions intra- and inter-organisms
- Coordinators: M.-F. Sagot (France), A. Marchetti-Spaccamela (Univ. Rome, Italy), L. Stougie (Free Univ. Amsterdam and CWI, the Netherlands), P. Crescenzi, Univ. Florence, Italy), N. Pisanti (Univ. Pise, Italy)
- BAMBOO participant(s): Whole BAMBOO Team
- Type: INRIA International Partner
- Web page: [http://piluc.dsi.unifi.it/amici/](http://piluc.dsi.unifi.it/amici/)

7.3.2. INRIA-Faperj (Brazil) project: RAMPA
- Title: Bioinformatics for the Reconstruction and Analysis of the Metabolism of PArasites
- Coordinators: M.-F. Sagot (France), A. T. Vasconcelos (LNCC, Brazil)
- BAMBOO participant(s): Whole BAMBOO Team
- Type: Faperj-INRIA
- Web page: not yet available

7.4. Exterior research visitors

Etienne Birmelé, Associate Professor, University of Évry, France, various visits of 1 week until délégation in Sept. 2011
Pierluigi Crescenzi, Professor, University of Florence, Italy, various visits of 1-2 weeks
Roberto Grossi, Professor, University of Pisa, Italy, various visits of 1 week
Alberto Marchetti-Spaccamela, Professor, University La Sapienza, Rome, Italy, visit of 1 week
Andrea Marino, PhD student (Supervisor: Pierluigi Crescenzi), University of Florence, Italy, various visits of 1-2 weeks
Eduardo Moreno, Associate Professor, University Adolfo Ibañez, Chile, visit of 1 week
Nadia Pisanti, Associate Professor, University of Pisa, Italy, various visits of 1 week
Gianluca Rossi, Associate Professor, University of Rome Tor Vergata, Italy, visit of 1 week
Leen Stougie, Free University Amsterdam and CWI, Amsterdam, the Netherlands, visit of 1 week
Ana Tereza Vasconcelos, CNPq Grant, Lab Nacional de Computação Científica, Petrópolis, Brazil, visit of 1 year from Sept. 1st, 2010 until Aug. 31st, 2011
Susana Vinga, Professor, INESC-ID, IST Lisbon, Portugal, visit of 1 week
Maria Emilia Walter Telles, University of Brasília, Brazil, visit of 3 months
7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. DIGITEO and Cancéropôle IdF

The DIGITEO IdF LSC ALMA program, coordinated by C. Bonnet (DISCO team, INRIA Saclay IdF) studies a model of leukaemia based on previous works by M. Adimy and F. Crauste (Lyon), with theoretical model design adjustments and analysis in J. L. Avila Alonso’s Ph D thesis (supervised by C. Bonnet, S. Niculescu and J. Clairambault) and experimental parameter identification initiated by F. Merhi, postdoc of Bang (Dec. 2010-Nov. 2011), working at St. Antoine Hospital (Paris), under the supervision of J. Clairambault and C. Bonnet to link experimental and theoretical aspects and of J.-P. Marie and R. Tang (INSERM-UPMC) to supervise biological experiments on leukaemic cells. ALMA has been granted for 3 years, beginning in December 2010.

More recently, the Cancéropôle IdF ALMA2 program has taken over the experimental identification part in St. Antoine Hospital, together with further model design in Bang - and Disco with the continuation of J.L. Avila’s PhD thesis -, for 18 months (Oct. 2011-March 2013) with the postdoc of A. Ballesta, shared between J.-P. Marie’s team and Bang. With this postdoc project will also be developed the theoretical and experimental - in leukaemic cell cultures - study of combined therapies by classical cytotoxics (anthracyclins, aracytin) and recently available targeted therapies (anti-Flt-3). A possible emergence of drug resistance to these drugs is also a question that will be studied both theoretically and experimentally in leukaemic cell cultures, in relation with the interdisciplinary French consortium DarEvCan (cf. supra “Optimisation of cancer chemotherapy”) in which both Bang and J.-P. Marie’s team participate.

7.1.2. INRA

Collaboration with INRA (Isabelle Hue, Juhui Wang, Alain Trubuil) on Trophoblast development. One PhD student position in Bang (Chadha Chettaoui) is funded within the Doctoral School Ecole du Vivant, Paris.

7.2. National Initiatives

7.2.1. ANR program Bimod.

This ANR program, coordinated by V. Volpert (Lyon), involves 3 partners: CNRS (Institut Camille Jordan) in Lyon (V. Volpert), University Bordeaux II (P. Magal) and INRIA (Bang project-team and DISCO team, Saclay IdF). It associates PDE models, both spatial and physiologically structured, with individual-based models in hybrid models to represent cancer growth (leukaemia and colorectal cancer) and therapy. It has been granted for 4 years, beginning in December 2010.

7.2.2. ANR TOPPAZ

(TOPPAZ (Theory and Observations of Polymerisation processes in Prion and Alzheimer diseases) is a 3-year (2009-2012) research project financed by ANR grant “programme blanc” and headed by Marie Doumic-Jauffret.

It involves two teams, a mathematical and numerical team (B. Perthame, V. Calvez, P. Gabriel, T. Lepoutre, P. Michel, and a team in Brazil headed by J. Zubelli) and a biophysicist team headed by H. Rezaei. It has allowed to finance the post-doctoral contract of F. Charles and the 1-year grant of L. M. Tine.

The general goal is to develop new mathematical and numerical tools for polymerisation processes, in a strong link with experimentalists and with direct application to experimental data designed by the biologists’ team. The achievements of ANR TOPPAZ are described in Sections 5.1.4 and 5.1.5.
7.2.3. **ARC Nautilus**

Participation in the ARC Nautilus on the coupling between hydrodynamics and biology (phytoplankton) in collaboration with the EPI COMORE, LOCEAN, LOV.


7.2.4. **ANR METHODE**

Participation in the ANR project “METHODE” (Modélisation de l’Écoulement sur une Topographie avec des Hétérogénéités Orientées et des Différences d’Échelles / Modelling of the flow on a topography with oriented heterogeneities and different scales) in collaboration with Orléans University, BRGM, CEMAGREF, CERMICS, INRA.

7.2.5. **ANR Sine2Arti**

Participation in the ANR project Sine2Arti. The project considers tissue homeostasis and cell reprogramming.

7.2.6. **ANR PhysCancer**

Participation in the ANR project Physics of Cancer. The project studies the impact of a constraining extracellular material on the growth and division of cells and cellular aggregates.

7.2.7. **GDR DarEvCan**

The GDR DarEvCan, for Darwinian Evolution and Cancer, is an interdisciplinary consortium which associates 10 teams in France around the theme of evolution and cancer, in particular evolution of cancer cell populations towards drug resistance. It has held its first national meeting in December in Paris. The Bang team takes an active part in its development.


7.3. **European Initiatives**

7.3.1. **ERASysbio+ C5Sys European network.**

This European program ( [http://www.erasysbio.net/index.php?index=272](http://www.erasysbio.net/index.php?index=272) ) has begun in April 2010, with the title “Circadian and cell cycle clock systems in cancer”. Coordinated by F. Lévi (Villejuif) and D. Rand (Warwick), it studies both from a theoretical and from an experimental viewpoint the relationships between molecular circadian clocks and the cell division cycle, in cancer and in healthy tissues. It has been granted for 3 years. A postdoctoral fellow (F. Billy) works on this subject.

7.3.2. **EU-project PASSPORT**


7.3.3. **EU-project CANCERSYS**

Participation in the European network CANCERSYS on modelling tumour genesis in liver. This project includes also collaborators from the Paris region. A PhD student (William Weens) works on this subject.

- **Title:** CANCERSYS
- **Type:** COOPERATION (SANTE)
- **Instrument:** Specific Targeted Research Project (STREP)
- **Duration:** November 2008 - October 2011
- **Coordinator:** Univ. Dortmund (Leibniz Research Centre for Working Environment and Human Factors) (Germany)
7.3.4. EU-project NOTOX

Participation in the European network NOTOX on modelling drug detoxication by liver cells cultivated in bioreactors.

- **Title:** NOTOX
- **Type:** COOPERATION (SANTE)
- **Instrument:** Integrated Project (IP)
- **Duration:** January 2011 - December 2015
- **Coordinator:** UNIVERSITAET DES SAARLANDES (Germany)

7.3.5. INRIA Associate Team QUANTISS

Title: Towards quantitative tissue simulations
INRIA principal investigator: Dirk Drasdo

International Partner:
- **Institution:** University of Leipzig (Germany)
- **Laboratory:** IZBI

Duration: 2010 - 2012

See also: [http://www.msysbio.com/ea](http://www.msysbio.com/ea)

In a recent joint work including members of the BANG and IZBI-teams we were able to predict a novel, so far unrecognized mechanism that is fundamental for a correct regeneration process during liver regeneration by a mathematical hybrid agent-based simulation model (Hoehme et. al., PNAS, 2010). To identify the model assumptions and the start configuration in the simulation model we combined quantitative information from experimental images on a regenerating liver prior and during regeneration after drug intoxication from animal data with experimental observations of isolated cell-cell-interaction processes from in-vitro (outside the living organism) cell cultures. The model was able to mimic the regeneration process quantitatively. The key mechanism predicted by our mathematical model could subsequently be validated experimentally. It was one of a very few cases in tissue organization where an important mechanism could be correctly predicted by a mathematical model. The modeling work was jointly performed by researchers in INRIA and IZBI. A similar strategy is now performed in other modeling applications to tissue organization included in this collaboration. For this purpose image processing and analysis tools as well as simulation software, developed at IZBI and INRIA, are being extended. The collaboration pursues three major topics (T):

- **T1:** Simulation of liver disease and regeneration. This includes liver regeneration after partial hepatectomy (partial removal of liver tissue), steatosis, fibrosis, and liver cancerogenesis (development of liver cancer). Partial hepatectomy is applied after severe lesions, for example caused by liver cancer. Many projects aim at developing multi-scale models including various cell types, spatial tissue architecture, metabolism, cell-cell signaling and signal transduction. The project T1 includes many experimental partners within national and EU projects, most of them in Germany.
- **T2:** Simulation of tumor growth and therapy. The role of erythropoietin in Lung cancer therapy should be evaluated and improved therapy schedules should be developed. The model will be multi-level spanning the molecular scale up to the centimeter-scale. This project includes about 15 partner teams in Germany, 11 of them experimental teams and includes the German Cancer Center, a few years ago with a nobel price.
- **T3:** Simulation of cell differentiation and lineage specification in multi-cellular aggregates and structured tissues and the role of cell aging. This project addresses the hot topic of stem cell organization in normal and cancer tissues with a special focus on the processes of stem cell transformation and cell re-programming.
- **T4:** tumor development and cell aging.
7.3.6. Others

The German part of the BANG project-team and associated team in Leipzig takes part in the Germany-wide Virtual Liver network (VLN) on Systems Biology of the liver (funded by the BMBF) from the molecular level up to the whole organ and body levels. This network is the follow-up of the former Systems Biology network on the “Hepatocyte” through which two PhD students (S. Höhme and A. Krinner) were funded, having recently graduated.

The project includes collaborations within about 10 subprojects with many research groups within Germany (including our main partners from Hepatosys, J.G. Hengstler, Leibniz Research Center, Dortmund, and R. Gebhardt, Univ. of Leipzig).

Key running collaborations exist with the Leibniz Research Center in Dortmund and with the Biochemistry-department of the University of Leipzig on liver regeneration after drug-induced damage and partial hepatectomy. Several other collaborations within the German Consortium on LungCancerSys (BMBF) on the role of Erythropoietin on Lung Cancer must also be mentioned and with the University of Saarbrücken in modelling drug toxicity to hepatocytes in-vitro. Some of the former collaborations are now continued within the different EU projects enumerated above.

7.4. International actions

7.4.1. M3CD

A new EuroMed3+3 program, M3CD Mathematical Models and Methods in Cell Dynamics has been accepted in December for 2 [+ 2: renewal] years. It associates 2 INRIA teams: Bang and Dracula (Mostafa Adimy, Lyon) with the IAC-CNR in Rome (Roberto Natalini), the LMDP team in Marrakech (Hassan Hbid) and the MoMinBi team in Tunis (Slimane BenMiled) to work on the general theme “Mathematical Models and Methods in Cell Dynamics”.

7.4.2. INRIA-Conicyt


7.4.3. Visits of International Scientists

7.4.3.1. Professors

- H.T. Banks (april, 2011, 1 week)
  - Subject: Mathematical modelling of intracellular negative feedback systems
  - Institution: NC State University (Raleigh)(USA)
- Carlos Pares (from march 14th to 18th, 2011)
  - Subject: Modeling and simulation of hyperbolic systems
  - Institution: University of Malaga (Spain)

7.4.3.2. Internship

- Karina VILCHES (from Feb 2011 until Dec 2011)
  - Subject: Modeling and control of multidrug therapy
  - Institution: University of Chile (Santiago) (Chile)
6. Partnerships and Cooperations

6.1. Regional Initiatives

6.1.1. Evolution of endosymbiont genomes

Participants: Guillaume Beslon, Stephan Fischer, Carole Knibbe, David P. Parsons, Bérénice Batut.

Endosymbiotic organisms always own shorter genomes than free living ones. This particularly the case in the prokaryotic kingdom. Many hypothesis have been proposed in the literature to explain this observation but it is very difficult to disentangle the effect of the proposed mechanisms and to assess whether they lead – or not – to genome reduction. We have received a BQR grant from INSA-Lyon to investigate this question by a joint work with aevol (to test in silico the different hypothesis) and with comparative genomic approaches (to better characterize the structural difference between short and long genomes). Total amount funded: 15,000 euros.

6.2. National Initiative

6.2.1. Evolution of bacterial genomes

Participants: Guillaume Beslon, Stephan Fischer, Carole Knibbe, David P. Parsons, Bérénice Batut.

Our work on the Aevol software has received two interdisciplinary grants from the CNRS: an inter-institute grant (PEPII) and a grant from the INS2I institute (PEPS). In both cases, the objective is to trigger collaborations with other computer science teams, life science teams or mathematicians. In the case of the PEPS project, our collaborators are the LIP (Lyon) and LAPM (Grenoble). In the case of the PEPII project, we collaborate with the LIP (Lyon), LAPM (Grenoble), LBBE (Lyon) and ICJ (Lyon).

6.2.2. ColAge

Participants: Hugues Berry, Anne-Sophie Coquel.

ColAge is a 4-year research project launched in early 2009 as a Large-Scale Initiative Action co-funded by the French national research institutes INRIA (computer science) and Inserm (medicine and health). We search for natural and engineering solutions to the control of bacterial growth and aging using both systems biology and synthetic biology approaches. Our main strategy is to leverage synergies resulting from day-to-day collaborations between computer scientists and cell biologists. The research topics on aging in bacteria above is one of the ColAge workpackages. Supervisor: H. Berry, EPI Beagle. Total amount funded (for 2009-2010): 330,000 euros. Further information available at http://colage.saclay.inria.fr/.

In 2010, ColAge fostered the emergence of two other grants/funding by the French national agency for research, ANR: Pagdeg (led by A. Lindner, see below) and GeMCo (led by M. Chaves, http://www-sop.inria.fr/members/Madalena.Chaves/).

6.2.3. PAGDEG

Participants: Hugues Berry, Anne-Sophie Coquel, Ariel Lindner, Y. Chen, L. Moisan.

A three-year project (2010-2012) funded by the French National Agency for Research (ANR), Call “PIRIBIO 2009” (Programme interdisciplinaire de recherche sur les systèmes moléculaires et cellulaires et d’innovation biomédicale). We study the causes and consequences of protein aggregation in cellular degeneration in bacteria combining innovative experimental (microfluidics, quantitative biology) and computer simulation (individual based-modeling, ODEs) approaches. Supervisor: A. Lindner (INSERM, Paris). Total amount funded: 450,000 euros.
6.2.4. Stochagene
Participants: Hugues Berry, Guillaume Beslon, Gaël Kaneko.

Stochagene is a four-year project (2011-2015) funded by the French National Agency for Research (ANR), Call “Blanc 2011”. The objective of the project is to identify the molecular causes of stochasticity in gene expression by experimental and modeling approaches. Supervisor: O. Gandrillon (CNRS, Lyon). Total amount funded: 466,000 euros.

6.2.5. NéoBG (pour une théorie biologiquement réaliste de l’apprentissage par renforcement)
Participants: Hugues Berry, Jules Lalouette.

NéoBG is an interdisciplinary project funded by the CNRS (Appel Projets exploratoires pluridisciplinaires inter-instituts – PEPII – 2011-2012). Total amount funded for Beagle: 6 000 €.

6.2.6. Partnership with F. Taddei’s group, INSERM U1001, Cochin hospital Paris
Participants: Guillaume Beslon, Carole Knibbe, David P. Parsons, Hugues Berry, Anne-Sophie Coquel.

Strong collaboration links exist between Beagle and F. Taddei’s and A. Lindner’s group, in Paris: First, A. Lindner and H. Berry collaborate on the study of aging in bacteria. Both co-supervise A.S. Coquel’s PhD within grants ColAge and Pagdeg (see above). Moreover, Aevol, a software developed by our team (see above), is used by the INSERM experimentalist group in Paris: with our help, D. Misevic and F. Taddei use it to study the evolution of cooperation in bacteria: Under which conditions can cooperation emerge? What kind of genetic architecture evolves when cooperation arises?

6.2.7. Partnership with D. Schneider’s group, LAPM, Univ. Joseph Fourier, Grenoble
Participants: Guillaume Beslon, Stephan Fischer, Carole Knibbe, David P. Parsons, Bérénice Batut.

The team of Dominique Schneider is composed of life scientists developing experimental evolution strategies with micro-organisms. We are engaged in a close collaboration with this team since the methodology they use is very similar to the one we develop with aevol (though they are studying real organisms). Several projects have been submitted this year (ANR, Labex, Investissement d’avenir en bioinformatique) and we are waiting for the results.

6.2.8. Astrocytic regulation of neuronal network activity
Participants: Hugues Berry, Jules Lalouette.

Research Networks Program in Computational Neurosciences and Computational Cognitive Sciences of the High Council for Scientific and Technological Cooperation between France-Israel. Total amount funded for Beagle: 80 000 €.

Healthy functionality of the central nervous system (CNS) relies on intricate neuron-glia networks. Recent data suggest that glial cells, including astrocytes, play a crucial role in the way information is processed and stored by the brain. In particular, synapses should not be considered bipartite, but rather tripartite structures, comprising of the pre-synaptic terminal, the post-synaptic one and the surrounding astrocyte. Moreover, glial cells, like neurons, also form intricate networks of cells and are linked by gap junctions to afford long-range communication via the propagation of calcium waves. Therefore, neurons and astrocytes form intertwined neuron-glial networks supporting active partnership between the two cell populations. Hence, understanding the nature of the neuron-glia interaction is essential to fully understand how the brain functions, and will serve as a stepping stone for deciphering disorders of the CNS. Our long-term goal is to reveal the underlying mechanism that controls and regulates the activity of combined neuron-glial networks. The specific objectives of this application, which are fundamental in the pursuit of that goal, are (1) to determine the properties of astrocytic calcium wave propagation and (2) to reveal how astrocyte signals dynamically affect synaptic information transfer, thus regulating neuronal network activity. To achieve these objectives we will employ a methodology that combines corresponding theoretical and experimental investigations of small neuron-glial networks. We will use unique cortical cultures made of several hundred well-identified cells, thus facilitating very systematic investigation in a manner that is fully compatible with our analytical tools. The significance
of understanding glia-neuron interactions is several-fold as it pertains to a very wide range of applications, from basic understanding of neuronal activity, to developing therapeutic strategies toward the treatment of neurological disorders. Here, we will focus on ataxia-telangiectasia (A-T), a progressive neurodegenerative disorder induced by mutations in the ATM gene encoding the protein kinase ATM, a key player in the DNA damage response. Leveraging the possibilities offered by our joint experimental and theoretical approach, we will be able to investigate heterogeneous neuron-glial networks where one element comes from a diseased mouse model and the other from healthy (WT) animals. This novel approach will provide us with a unique opportunity to uncover the cellular origin of these pathologies.
8. Partnerships and Cooperations

8.1. Regional Initiatives

Co-direction of a PhD thesis by J-M. Monnez:

- Partner: Ecole de Hautes Etudes en Santé Publique (Nancy).
- Title: Influence of socio-economic and environmental characteristics on infant mortality.
- PhD thesis of M. Lalloué.

Regional project leaded by T. Bastogne:

- Partners: Contrat de Projets Etat-Région, MISN (Modélisation, Information et Système Numérique), Thème AOC (Analyse, Optimisation et Contrôle).
- Title: EMC2 (Experimental design, Modeling and Control in Cancerology).

8.2. National Initiatives

- C. Lacaux is member of the MATAIM (Modèles Anisotropes de Textures. Applications à l’Imagerie Médicale) ANR project, leaded by F. Richard (University of Provence).
- S. Tindel is co-leader the ECRU (Exploration des Chemins Rugueux) ANR project, jointly with M. Gubinelli (University of Paris Dauphine).
- P. Vallois is member of the MASTERIE (Malliavin Stein Random Irregular Equation) ANR project, leaded by F. Russo (ENSTA, Paris).
- T. Bastogne is leader of the MOCOBIO (MOdeling and COntrol of heterogeneous systems in systems BIOlogy) CNRS-PEPS project.
- T. Bastogne is member of the PDTX (Active Nanoplatforms for Photodynamic Therapy) ANR project, leaded by M. Verelst (Université Paul Sabatier, Toulouse)
- T. Bastogne is member of the Nano-VTP (Nanoparticles for Imaging and Vascular Photodynamic Treatment of Brain Tumors) ANR project, leaded by M. Barberi-Heyob (Centre de Recherche en Automatique de Nancy, Centre Alexis Vautrin).

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: UGR (Université de la Grande Région)
Project acronym: I-DERBI
Project title: I-DERBI
Duration: January 2010 - April 2012
Coordinator: C. Carlberg (Luxembourg)
Other partners: Université du Luxembourg, Université de Liège (Belgium), Saarland University (Germany)
Abstract: We stand at the brink of a fundamental change in how medicine will be practiced in the next 5-20 years. This change will require the unprecedented integration of biology, medicine, technology and computation as well as societal issues of major importance: ethical, regulatory, public policy, economic, and others. These needs have encouraged the emergence of a biology-based inter-disciplinary study field, systems biology, which focuses on the modeling of complex biological systems. Systems biology covers a large spectrum of applications: biomedicine, bioprocesses engineering, environmental science and pharmaceutical discovery. The ambition of the I-DERBI pilot project is to initiate and develop synergy of education and research in Systems Biology within the Grande Région.

8.3.2. Major European Organizations with which Bigs has followed Collaborations

Partner: Universitat Autònoma de Barcelona, Departament de Matemàtiques (Spain).
Subject: Stochastic model for bacteriophage systems.

Partner: TU Kaiserslautern, Department of Mathematics.
Subject: Parameter estimation for differential systems driven by Gaussian processes.

8.4. International Initiatives

8.4.1. Internships

Yosra Chemli
Subject: Statistical Emulation of High Dimensional Biological Dynamic Models
Institution: Ecole Polytechnique de Tunisie (Tunisia)

Raouf Souabni
Subject: Simulation of the light propagation in biological tissues. Application to interstitial photodynamic therapy.
Institution: Université de Tunis El Manar - Faculté des Sciences (FST) (Tunisia)

8.5. Teaching

BIGS is a team whose composition includes University staff only. All members teach numerous courses, ranging from L1 to M2 levels.

PhD & HdR:


PhD : R. Keijn, *Modélisation de la croissance d’une tumeur après traitement par radiothérapie*, Université de Nancy 1, 2/12/2011, Advisors: T. Bastogne, P. Vallois.


8. Partnerships and Cooperations

8.1. National initiatives

- **Shamash**: Shamash is a project funded by the ANR in the national program for research in bioenergy. Its objective is to produce biodiesel from microalgae. Shamash, coordinated by O. Bernard, includes 9 partners, for a total budget of 2.8 Millions Euros. The role of BIOCORE is to design a model of the process in order to better understand the dynamical mechanisms that lead to the transient storage of lipids. The second step will then consist in defining optimal conditions to maximize the oil production. See [http://www-sop.inria.fr/comore/shamash/](http://www-sop.inria.fr/comore/shamash/)

- **Symbiose**: BIOCORE takes part in the Symbiose ANR project. The objective of this project is both to improve the energetic balance of biofuel microalgal productions and to recycle nitrogen and phosphorus. The project proposes to study the coupling between a microalgal production system and an anaerobic digester. The objectives of BIOCORE are to propose a model of the coupled system, and to compute the optimal fluxes between the various compartments in order to optimize the energy recovery. See [http://anr-symbiose.org/](http://anr-symbiose.org/)

- **Salinalgue**: BIOCORE is involved in the FUI Salinalgue project. The objective of this project is to take benefit of endemic microalgal species in areas of high salinity (previously used to produce salt) to produce both biofuel (either lipid based or methane) and co products. BIOCORE is in charge of lab scale experiments and of the modelling of the process.

- **GDR PROBBE**: The objective of this GDR is the development of new biotechnological processes based on microorganisms producing metabolites which can be used as fuel for transportation (lipids, sugars, methane, hydrogen, ...). BIOCORE is taking part mainly in the modelling and control aspects of the processes involving anaerobic bacteria or microalgae.

- **Nautilus**: O. Bernard is coordinating the Nautilus ARC whose objective is to understand and model the coupling between hydrodynamics and microalga photosynthesis.

- **ColAge**: The goal of this joint INRIA-INSERM consortium is to study bacterial growth and aging by using mathematical modelling and computational predictions to design and implement a de novo biological system. This Large-Scale Initiative Action is partly funded by INRIA and supervised by H. Berry (Alchemy, INRIA).

- **GeMCo**: The objective of this project is to do model reduction, experimental validation, and control for the gene expression machinery in E. coli. The project is funded by ANR (2010-BLAN-0201-01) and coordinated by M. Chaves (BIOCORE, INRIA)

- **RBHS**: INRA-SPE is funding the project “Rôle de la biodiversité et des hétérogénéités spatiotemporelles de la distribution des ravageurs et de leurs ennemis naturels dans les phénomènes de régulations biologiques” in which BIOCORE is a partner with INRA Sophia Antipolis and INRA Avignon (2009-2011)

- **Eco-tuta**: INRA-SPE is funding the project “Ecologie des communautés dans les agro-écosystèmes et implications pour la lutte biologique contre une espèce invasive: le cas Tuta absoluta sur tomate” in which BIOCORE is a partner with INRA Sophia Antipolis (2010-2012).

- **Propagules**: INRA-SPE is funding the project “Effet de différentes composantes de la pression de propagules sur le succès d’établissement d’un auxiliaire de lutte biologique” in which BIOCORE is a partner with INRA Sophia Antipolis (2011-2013).
• **Metacarpe:** This INRA SPE-GAP-EFPA-EA project (call “Gestion durable des résistances des bio-agresseurs”) is entitled “Modélisation de l’évolution des traits d’histoire de vie en lien avec l’agressivité des champignons parasites biotrophes : application au pathosystème rouille-peuplier”. BIOCORE is taking part with CIRAD, INRA Sophia Antipolis Nancy and Rennes (2010-2012).

• **COREV:** BIOCORE is an active participant in the research group COREV (Modèles et théories pour le contrôle de ressources vivantes et la gestion de systèmes écologiques).

• **RTP-M3D:** BIOCORE is a participant in the RTP-M3D workgroup (Mathématiques et décision pour le développement durable) that is supported by the “Environment and sustainable growth” department of CNRS. L. Mailleret is one of the co-leaders of M3D.

• **Seminar:** BIOCORE organizes a regular seminar “Modelling and control of ecosystems” at the station zoologique of Villefranche-sur-Mer or at INRIA.

### 8.2. European Initiatives

#### 8.2.1. FP7 Projects

**8.2.1.1. PURE**

- **Title:** Pesticide Use-and-Risk reduction in European farming systems with Integrated Pest Management
- **Type:** COOPERATION (ICT)
- **Instrument:** Collaborative Project (CP)
- **Duration:** 2011 - 2014
- **Coordinator:** Françoise Lescourret (INRA Avignon, FR)


Joint Research Centre - Institute for Prospective Technological Studies - JRC-IPTS (EU) **Extension:** Knowledge Centre for Agriculture - VFL (DK) Association de Coordination Technique Agricole - ACTA (FR) **Industry:** Bayer Crop Science (DE) BIOTOP (FR) Natural Plant Protection (FR) Burkard Manufacturing Co Ltd (UK) Blgg Bv (NL) **Management:** INRA Transfert (FR)

See also: [http://www.pure-ipm.eu/project](http://www.pure-ipm.eu/project)

**Abstract:** The overall objective of PURE is to provide practical IPM solutions to reduce dependence on pesticides in selected major farming systems in Europe, thereby contributing to a reduction of the risks to human health and the environment and facilitating the implementation of the pesticides package legislation while ensuring continued food production of sufficient quality. PURE will provide integrated pest management (IPM) solutions and a practical toolbox for their implementation in key European farming systems (annual arable and vegetable, perennial, and protected crops) in which reduction of pesticide use and better control of pests will have major effects. In that project, L. Mailleret develops modelling approaches dedicated to the optimisation of plant protection methods relying on biological control and integrated pest management.

#### 8.2.2. Major European Organizations with which you have followed Collaborations

- **Univ. Polytechnique Mons:** Service d’Automatique (B)
- **Modelling of photosynthesis**
Imperial college, Department of Chemical engineering (UK)
Modelling and optimization of microalgal based processes.

Imperial College, Centre for Synthetic Biology and Innovation, Dept. of Bioengineering (UK)
Study of metabolic/genetic models

University of Stuttgart, Institute for Systems Theory and Automatic Control (D)
Identification of gene networks

8.3. International Initiatives

8.3.1. INRIA International Partners
Universidad Técnica Federico Santa María, Departamento de Matemática, Valparaíso, Chile
Universidad de Chile, Departamento de Matemáticas, Nuñoa Santiago, Chile
Ben-Gurion University of the Negev, Microalgal Biotechnology Laboratory, Beer Sheva, Israel
Center for Environmental Technology and Engineering, Massey University, Palmerston North, New Zealand.

8.3.2. Visits of International Scientists
We only list the visitors that stayed more than 2 days in our project-team

- Benoit Chachuat (Imperial College, Department of chemical engineering, UK), 1 week
- Claude Aflalo (Ben Gurion University of the Neguev, Israel), 1 week;
- Hugh McIntyre (Dalhousie University, Department of Oceanography, Halifax, Canada), 1 week.
- Quentin Béchet (Center for Environmental Technology and Engineering, School of Engineering and Advanced Technology, Massey University, Palmerston North, New Zealand), 1 month.
- Mihaela Sbarciog (Université de Mons, Belgium), 2 days.
- Delphine Ropers, Eugenio Cinquemani, Sara Berthoumieux, Stephane Pinhal (INRIA Rhone-Alpes) 3 days.

8.3.2.1. Internship
Ismail Belgacem (University of Tlemcen, Algeria) received an internship grant from the DRI and stayed in BIOCORE between april and august. He is now pursuing a PhD Thesis in BIOCORE.

8.4. Project-team seminar
BIOCORE organized a 3-day seminar in October in Porquerolles. On this occasion, every member of the project-team presented his/her recent results and brainstorming sessions were organised.
7. Partnerships and Cooperations

7.1. Regional Initiatives

Bioinformatics is a multidisciplinary discipline by nature and our work relies on collaborations with several biological research groups.

- The project on nonribosomal peptide synthesis is based on a collaboration with the ProBioGEM laboratory (Laboratoire des Procédés Biologiques Génie Enzymatique et Microbien), headed by Pr. Dhulster, University Lille 1. This laboratory develops methods to produce and extract active peptides in agriculture or food. The PhD work of Ségo Caboche defended in 2009 was co-supervised by Valérie Leclère from ProBioGem. A PhD work started on this subject in 2008: Aurélien Vanvlassenbroeck is working at ProBioGEM and is co-supervised by Maude Pupin.

- We collaborate with the Laboratoire de Génétique et Évolution des Populations Végétales (UMR CNRS 8016), Université de Lille 1 on the study of genomic rearrangements in the mitochondrial genome of higher plants. The goal is to identify evolutionary forces and molecular mechanisms that modeled the present diversity of mitochondrial genome at the species level, and in particular potentially active recombination sequences that have been used in the course of time. Data is acquired thanks to Genoscope projects (in beet and silene). A PhD work defended in 2010 by Aude Darraçq was co-supervised by Pascal Touzet from GEPV.

- At the end of 2010, we started a collaboration with the sequencing platform of Université Lille 2 and IRCL (M. Figeac) and the hematology lab of Lille hospital (N. Grardel, C. Roumier, C. Preudhomme), on the diagnosis of leukemia residual disease.

- Our team is a member of the PPF Bioinformatique. This is an initiative of the University Lille 1 that coordinates public bioinformatics activities at the local level for the period 2010-13.

7.2. National Initiatives

- ANR MAPPI (2010-2013). ANR Mappi (2010-2013): National funding from the French Agency Research (call Conception and Simulation). This project involves four partners: LIAFA (Université Paris 7), SYMBIOSE (INRIA Rennes), Genoscope (French National Center for Sequencing) and BONSAI. The topic is Nouvelles approches algorithmiques et bioinformatiques pour l’analyse des grandes masses de données issues des séquenciers de nouvelle génération.

- RNAspace. This project conducted in collaboration with INRA Toulouse benefited from a grant of RNG-Renabi, national network for bioinformatics, and is one of the topics of the project RENABI-IFB (national call infrastructures Biologie Santé). Project web site: http://www.rnaspace.org/

- A collaboration with the PlasmoExplore ANR project (Laboratoire d’Informatique et Microélectronique de Montpellier) led to a publication [2]. We propose in this paper a new evolutionary scenario for the evolution of Plasmodium falciparum, the major agent of malignant malaria. Results issued from the collaboration with the ERC founding PopPhyl are in preparation (Institut des Sciences de l’Evolution de Montpellier).

- The following scientists were invited in 2011 to give a talk at the team seminar: Patrick Meyer (Université Libre de Bruxelles), José Gualberto (Institut de Biologie Moléculaire des Plantes, Strasbourg), Robert Giegerich (Université Bielefeld).
7.3. European Initiatives

- PHC Procope PARALLEL-ADP (2010-2011), bilateral cooperation project with U. Bielefeld (R. Giegerich, P. Steffen, Germany). The goal is to work on a generic parallelization on the ADP (algebraic dynamic programming) methodology. In this context, R. Giegerich spent several days in Lille in November.

7.4. International Initiatives

7.4.1. INRIA International Partners

A collaboration with the Université du Québec à Montréal (UQAM) and Simon Fraser University (SFU, Vancouver) on gene evolution, genomic rearrangement and ancestral genome reconstruction led to three publications this year [8], [6], [9].

7.4.2. Visits of International Scientists

Patrick Meyer (Université Libre de Bruxelles, October 2011, two weeks).
Robert Giegerich (University of Bielefeld, Germany, November 2011, three days).
6. Partnerships and Cooperations

6.1. National Initiatives

The ANR project MOMME, coordinated by Y. Coudière ended on November, 14th, 2011. It involved two partners, the Université de Nantes (Laboratoire de Mathématique Jean Leray – LMJL) and the ASCLEPIOS team.

6.2. European Initiatives

6.2.1. Major European Organizations with which you have followed Collaborations

Partner 1: CNR, IMATI (Italie) – G. Manzini.
Finite volume discretization on general, distorted meshes, for second order operators with anisotropy and discontinuities.

6.3. International Initiatives

We collaborate with Y. Bourgault from the Department of Mathematics and Statistics, University of Ottawa, Canada. It has been supported by the ANR MOMME, the Université de Nantes, the Région des Pays de la Loire and the Natural Sciences and Engineering of Research council of Canada.
8. Partnerships and Cooperations

8.1. Regional Initiatives

- Clime took part with Numtech and AirParif to the project “Votre Air”, from the call “Futur en Seine” organized by Cap Digital and notably supported by Île-de-France. Clime is in charge of providing data assimilation methods in order to generate analyses out of ADMS simulations and AirParif ground observations. The corresponding prototype is running operationnally and the results are available at http://votreair.airparif.fr/ and on Android and iOS applications.

- Clime is involved in the starting project PREQUALIF–IZNOGOUD–BARC, with many partners including the leading partner LSCE (“Laboratoire des Sciences du Climat et l’Environnement”), which aims at designing methods for the evaluation of the measures to be taken in the ZAPA areas (“Priority Areas for Air Quality Measures”). Clime will focus on the assimilation of observations to better evaluate the actual air quality.

8.2. National Initiatives

- The MSDAG project (Multiscale Data Assimilation in Geophysics) is an ANR SYSCOMM project. Four partners are in the project: CEREA (Clime project-team, Marc Bocquet, PI of the whole project), Fluminance (Étienne Mémin), Moise Project-team (Laurent Debreu), LSCE (Frédéric Chevallier). It has been extended to the end of September 2012.

- Clime is running the project MIDAR “Inverse modelling of deposition measurements in case of a radiological release”, under the framework of the LEFE-ASSIM program of INSU. This includes a cooperation with the Institute for Safety Problems of Nuclear Power Plants (National Academy of Sciences of Ukraine).

- Clime is part of the INSU/LEFE project ADOMOCA-2, which unites about ten French teams working in atmospheric chemistry data assimilation.

- Clime is one partner of the ANR SYSCOMM GeoFluids project. It focuses on the specification of tools to analyse geophysical fluid flows from image sequences. Clime objectives concern the definition of reduced models from image data.

- Clime takes part to the ANR project IDEA that addresses the propagation of wildland fires. Clime is in charge of the estimation of the uncertainties, based on sensitivity studies and ensemble simulations.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: COST Action ES104.
Project acronym: EuMetChem.
Project title: European framework for online integrated air quality and meteorology modelling.
Duration: January 2011 - December 2014.
Coordinator: Alexander Baklanov, Danish Meteorological Institute (DMI) Danemark.
Other partners: around 14 european laboratories, experts from United States, ECMWF.
Abstract: European framework for online integrated air quality and meteorology modelling (Eu-MetChem) - will focus on a new generation of online integrated Atmospheric Chemical Transport (ACT) and Meteorology (Numerical Weather Prediction and Climate) modelling with two-way interactions between different atmospheric processes including chemistry (both gases and aerosols), clouds, radiation, boundary layer, emissions, meteorology and climate. At least, two application areas of the integrated modelling are planned to be considered: (i) improved numerical weather prediction (NWP) and chemical weather forecasting (CWF) with short-term feedbacks of aerosols and chemistry on meteorological variables, and (ii) two-way interactions between atmospheric pollution/composition and climate variability/change. The framework will consist of four working groups namely: 1) Strategy and framework for online integrated modelling; 2) Interactions, parameterisations and feedback mechanisms; 3) Chemical data assimilation in integrated models; and finally 4) Evaluation, validation, and applications. Establishment of such a European framework (involving also key American experts) will enable the EU to develop world class capabilities in integrated ACT/NWP-Climate modelling systems, including research, forecasting and education.

8.3.2. Major European Organizations with which you have followed Collaborations

Partner: ERCIM working group “Environmental Modeling”.
The working group gathers laboratories working on developing models, processing environmental data or data assimilation.

Partner: CWI, Amsterdam (the Netherlands)
The collaboration deals with data assimilation based on minimax filtering. The objective is to apply a reduced form of a minimax filter to a high-dimensional air quality model and to process satellite images.

8.4. International Initiatives

8.4.1. INRIA International Partners

Partner: Chilean meteorological office (Dirección Meteorológica de Chile)
The partner produces its operational air quality forecasts with Polyphemus. The 3-day forecasts essentially cover Santiago. The forecasts are accessible online in the form of maps, time series and video (http://www.meteochile.cl/modelos.html).

Partner: Marine Hydrophysical Institute, Ukraine.
The collaboration concerns the study of the Black Sea surface circulation.

Partner: Institute of Numerical Mathematics, Russia
The collaboration concerns the estimation of uncertainty of the motion field derived from image data.

8.4.2. Participation In International Programs

Clime is running a two-year project under the PHC-DNIPRO program with the national university Taras Chevtchenko in Kiev. The subjects concerns the a posteriori minimax motion estimation from images.
7. Partnerships and Cooperations

7.1. Regional initiatives

7.1.1. Action Situated Informatics of the CPER

Participants: Laurent Bougrain, Octave Boussaton, Thierry Viéville.

In the framework of the Contrat de Projet État Région, we are contributing to the axis IS (Informatique Située) through the project CoBras whose goal is to study reinforcement learning to better control a robotic arm in a Brain-Machine interface. We bought a JACO robotic arm for wheelchair by Kinova.

7.2. National initiatives

7.2.1. DGE Ministry grant COMAC “Optimized multitechnique control of aeronautic composite structures”

Participants: Laurent Bougrain, Octave Boussaton, Marie Tonnelier.

The goal of this three-years project is to develop a powerful system of control on site, in production and in exploitation, of aeronautical pieces made of composite. It takes up the challenge of the precise, fast and local inspection on composite pieces of aeronautical structures new or in service by using techniques of non-destructive control more effective and faster to increase the lifespans of the structures of planes. This project requires a decision-making system including fast methods of diagnostic based on several optical technics as non-destructive control.

7.2.2. INRIA ADT project LOIC

Participants: Laurent Bougrain, Baptiste Payan.

This national software collaborative project with the INRIA research team BUNRAKU (Rennes) is devoted to OpenViBE (cf. § 5.4 ). The objectives of the project are:

- Software enhancement:
  - Make the software compatible with new devices
  - Create new BCI scenarios (e.g. SSVEP, hybrid BCI...)
  - Create new 3D visualization
  - Create bridges to other softwares (e.g. MATLAB, TurboFieldTrip, BCI 2000)
  - Enhance global computation performance

- Software dissemination:
  - Gforge, website, support management...
  - Create new demos and tutorials
  - Organise training sessions

- Explore new research topics:
  - Hybrid BCI (e.g. visual and auditory, visual and tactile)
  - Immersive neurofeedback
7.2.3. **ANR project KEOPS**  
**Participants:** Frédéric Alexandre, Laurent Bougrain, Thierry Viéville.  
This «ANR International White Project» involving NEUROMATHCOMP and CORTEX Inria EPI in France with the U. of Valparaiso, U. Tecnica Frederico Santa-Maria, and U. De Chili is a 3 years, 248 person-months, sensory biology, mathematical modeling, computational neuroscience and computer vision, project addressing the integration of non-standard behaviors from retinal neural sensors, dynamically rich, sparse and robust observed in natural conditions, into neural coding models and their translation into real, highly nonlinear, bio-engineering artificial solutions. An interdisciplinary platform for translation from neuroscience into bioengineering will seek convergence from experimental and analytical models, with a fine articulation between biologically inspired computation and nervous systems neural signal processing (coding / decoding).

7.2.4. **ANR project PHEROTAXIS**  
**Participants:** Dominique Martinez, Thomas Voegtlin.  
How can animals so successfully locate odour sources? This apparently innocuous question reveals on analysis unexpectedly deep issues concerning our understanding of the physical and biological world and offers interesting prospects for future applications. Pherotaxis focuses on communication by sex pheromones in moths. The main aim of the project is to integrate the abundant experimental data on the pheromone plumes, neural networks and search behaviour available in the literature, as well as that collected or being collected by us at the molecular, cellular, systemic and behavioural levels into a comprehensive global model of the pheromonal olfactory processes. To reach this objective, the consortium combines several groups of specialists with different and complementary fields, in physics (Institut Pasteur IP), neurobiology (INRA) and bio-robotics (INRIA).

7.2.5. **ANR project PHEROSYS**  
**Participants:** Dominique Martinez, Hana Belmabrouk.  
This collaborative project in systems Biology (ANR-BBSRC SysBio) with INRA (Paris, FR) and the University of Sussex (UK) explores olfactory coding in the insect pheromone pathway through models and experiments. More information available at [http://www.informatics.sussex.ac.uk/research/projects/PheroSys/index.php/](http://www.informatics.sussex.ac.uk/research/projects/PheroSys/index.php/).

7.2.6. **ANR project MAPS**  
**Participants:** Frédéric Alexandre, Yann Boniface, Nicolas Rougier, Wahiba Taouali, Thierry Viéville.  
This collaborative project with INCM (Marseille), UMR Perception and Movement (Marseille) and LIRIS (Lyon) that finished this year aimed at re-examining the relationship between structure and function in the brain, taking into account the topological (spatial aspects) and hodological (connectivity) constraints of the neuronal substrate. Particularly, we focused on the oculomotor function and explored the dynamical and topological representation of information in the superior colliculus.

7.2.7. **Project of the CNRS NeuroInformatics program on cortical signals to control a two-finger robotic hand (CorticoRobot)**  
**Participants:** Laurent Bougrain, Thierry Viéville.  
Nowadays, the understanding of the control of manual dexterity in primates can be reached. Over the last twenty years, thanks to improved techniques for intra-cranial recordings, several advances have been obtained in particular to predict the direction of movement of the upper limb. Recent work has shown that it is possible to predict from brain data the flexion and the strength of fingers. The main objective of this project is to study the control of two anthropomorphic fingers (index finger and thumb) through intra-cortical signals recorded in the monkey during grasping movements (precision grip), forecasting both the finger position and the electromyographic activity (EMG) of the muscles involved in the movements of these two fingers. The project aims at (i) acquiring high-quality recordings using an array of 96 micro-electrodes, (ii) improving our experimental site for the grasping, and (iii) evaluating new modelings. This project is a cooperation between the University of Paris V, the Mediterranean Institute for Cognitive Neuroscience (INCM) and the EPI CORTEX.
7.2.8. **Project CNRS PEPII: A large-scale, robotically embodied decision making model**

**Participants:** Frédéric Alexandre, Nicolas Rougier, Thierry Viéville.

This project is a collaboration between the “Institut des Maladies neuro-dégénératives” (UMR 5293, team “Approche systémique de la Boucle Extrapyramidale”), Supélec (“Information, Multimodalité, Signal”) and the Cortex team. This project aims at studying the decision making process viewed as a high-level brain function, actioned by a distributed network of cortical and sub-cortical structures, interconnected in positive and negative feedback loops.

7.2.9. **Project CNRS PEPII IMAVO**

**Participants:** Nicolas Rougier, Yann Boniface.

This project is a collaboration between the “Institut des Neurosciences Cognitives et Intégratives d’Aquitaine” (UMR 5287), the “Institut des Systèmes Intelligents et de Robotique” (Systèmes Intégrés Mobiles et Autonomes) and the LORIA (Maia and Cortex groups). This project aims at investigating model-free and model-based approaches in the decision process in order to propose a computational model of the decision process in simple tasks.

7.2.10. **Project of the CNRS NeuroInformatics program on oscillations in the rat olfactory bulb**

**Participants:** Axel Hutt, Dominique Martinez, Thomas Voegtlin.

This project is a collaboration between the CORTEX group and the "Neurosciences et Systèmes sensoriels" group (CNRS UMR 5020) at University of Lyon 1. The goal of the project is to understand why the frequency of LFP oscillations in the olfactory bulb changes during the respiratory cycle (alternance beta/gamma). The project combines experimental (in-vivo experiments) and theoretical work (computer simulations).

7.2.11. **Project INRA-INRIA**

**Participants:** Dominique Martinez, Thomas Voegtlin.

This project is a collaboration between the CORTEX group at INRIA and the PISC group at INRA. This project aims at reconstructing and explaining the encoding of the pheromone stimulus in the early neural pathway of the moth olfactory system. Models of single neurons based on Hodgkin-Huxley formalism are being developed to incorporate the ionic conductances found in experiments and to account for the overall properties of the cells. A network model is also built to account for the different response types in the moth olfactory system with respect to the temporal structure of the stimulus. The simulations are performed with the Sirene and Mvaspike softwares developed in our group.

7.3. **European Initiatives**

7.3.1. **FP7 Projet**

7.3.1.1. **MathAna**

Title: Mathematical Analysis of Anaesthesia
Type: IDEAS ()
Instrument: ERC Starting Grant (Starting)
Duration: January 2011 - December 2016
Coordinator: INRIA (France)

See also: ___ http://cordis.europa.eu/fetch?CALLER=FP7_PROJ_EN&ACTION=D&DOC=1&CAT=PROJ&RCN=97256 ___
Abstract: General anaesthesia is an important method in today’s hospital practice and especially in surgery. To supervise the depth of anaesthesia during surgery, the anaesthesist applies electroencephalography (EEG) and monitors the brain activity of the subject on the scalp. The applied monitoring machine calculates the change of the power spectrum of the brain signals to indicate the anaesthetic depth. This procedure is based on the finding that the concentration increase of the anaesthetic drug changes the EEG-power spectrum in a significant way. Although this procedure is applied world-wide, the underlying neural mechanism of the spectrum change is still unknown.

The project aims to elucidate the underlying neural mechanism by a detailed investigating a mathematical model of neural populations. The investigation is based on analytical calculations in a neural population model of the cortex involving intrinsic neural properties of brain areas and feedback loops to other areas, such as the loop between the cortex and the thalamus. Currently, there are two proposed mechanisms for the characteristic change of the power spectrum: a highly nonlinear jump in the activation (so-called phase transition) and a linear behaviour.

The project mainly focusses on the nonlinear jump to finally rule it out or support it. A subsequent comparison to previous experimental results aims to fit the physiological parameters. Since the cortex population is embedded into a network of other cortical areas and the thalamus, the corresponding analytical investigations takes into account external stochastic (from other brain areas) and time-periodic (thalamic) forces. To this end it is necessary to develop several novel nonlinear analysis technique of neural populations to derive the power spectrum close to the phase transition and conditions for physiological parameters.

7.3.1.2. FP7-ICT project NEUROCHEM

**Participant:** Dominique Martinez.

The European project NEUROCHEM explores biologically inspired computation for chemical sensing, in collaboration with the University of Barcelona, the royal institute of technology (Sweden), INRA (Paris), the university of Manchester, the university Pompeu Fabra (Spain), CNR-IMM (Italy) and the university of Leicester. More information is available at [http://www.neurochem-project.org/](http://www.neurochem-project.org/)

7.4. International Initiatives

7.4.1. INRIA Associate Teams

7.4.1.1. Cortina, associate team with Chile

**Participants:** Frédéric Alexandre, Thierry Viéville, Laurent Bougrain.

The goal of this associate team is to combine our complementary expertise, from experimental biology and mathematical models (U. de Valparaiso and U. Federico Santa-Maria) to computational neuroscience (CORTEX and NEUROMATHCOMP), in order to develop common tools for the analysis and formalization of neural coding and related sensory-motor loops. Recording and modeling spike trains from the retina neural network, an accessible part of the brain, is a difficult task that our partnership can address, what constitute an excellent and unique opportunity to work together sharing our experience and to focus in developing computational tools for methodological innovations.

7.4.2. Visits of International Scientists

7.4.2.1. Internships

NOUHA BOUJELBEN (from Feb 2011 until Jul 2011)

Subject: Information Reduction in the Brain
Institution: Ecole Nationale d’Ingénieurs de Sfax (Tunisia)

Juan Ignacio PORTA (from Mar 2011 until Jul 2011)
Subject: Randomly spiking neural fields
Institution: Universidad Nacional de Rosario (Argentina)

Mouid KESKES (from Feb 2011 until Jul 2011)

Subject: Modeling early vision with artificial neural networks
Institution: Ecole Nationale d’Ingénieurs de Tunis (Tunisia)

7.4.2.2. CONICYT-INRIA Program of Cooperation with Chile: AMVIS

Participants: Frédéric Alexandre, Thierry Viéville.

This project gathers chilean partners (U de Valparaiso and U Federico Santa-Maria) to french computational neuroscientist (CORTEX and NEUROMATHCOMP EPI). Recording and modeling non-standard retina neural network involved in sensori-motor perceptual tasks is targeted here: How visual signals are coded at earlier steps in the case of natural vision? What are their functions? What are the computational coding principles explaining (in artificial or biological system) the statistical properties of natural images?
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. SANOFI (Montpellier financial support)

Participants: Christian Geny (CHU Montpellier), Christine Azevedo-Coste, René Zapata (LIRMM), Lionel Lapierre (LIRMM).

Project SANOFI on developing a robot carrying a video camera for gait analysis of patients with neurological disorders.

8.2. National Initiatives

8.2.1. DEMAR / MXM I-Lab project

Participants: David Guiraud, David Andreu.

INRIA I-Lab project (2011-2014). 1 engineer (3 y.), 20keuros, ‘The aim of this INRIA’s national initiative is to favor the scientific collaboration and technological transfer of the innovation between DEMAR and MXM. The aim of this project is to prototype concepts conjointly patented like stimulation unit’s embedded sequencer and implantable FES controller with its dedicated software environment’. Partner: MXM.

8.2.2. Cosinus ANR

Participants: David Guiraud, Mitsuhiro Hayashibe, Christine Azevedo-Coste, Benjamin Gilles.


8.2.3. ADT SENSAS - SENSBIO

Participants: Christine Azevedo-Coste, David Guiraud, David Andreu.

SENSAS is an INRIA ADT (Actions de Développement Technologique), implying several INRIA project teams on the “SENsor network ApplicationS” theme. SENSAS aims to propose applications based on wireless sensor and actuator network nodes provided from the work done around senslab and senstools preliminary projects. SENSAS is organized around the following work packages:

- SensRob : Robotics applications
- SensBio : Bio-Logging applications
- SensMGT : Wireless sensor/actuator network management/configuration applications
- SensBox : Wireless sensor/actuator network simulation applications and tools

Our team is mainly implied in the SensBio work package, in particular for the following applications: Spinal Cord Injured Patients FES-Assisted Sit to Stand, Post-Stroke Hemiplegic Patient FES-correction of drop foot, Gait analysis of parkinson freezing and Motion analysis of longterm race data.

8.2.4. Programme de recherche en qualité hospitaliere (PREQHOS)

Participants: Leader: Jean-Christophe LUCET (GH Bichat - Claude Bernard), Christine Azevedo-Coste, Eric Fleury (INRIA), Bruno Grandsebastien (CHRU Lille).

Project: Surgery room behaviour and impact on infectious risks (ARIBO : Attitudes et Risque Infectieux au Bloc Operatoire)
8.3. European Initiatives

8.3.1. European project Time

Participants: David Guiraud, David Andreu, Fabien Soulier.

(2008-2012). 375keuros, "Transverse, Intrafascicular Multichannel Electrode system for induction of sensation and treatment of phantom limb pain in amputees". Partners: AAU (Aalborg, Denmark), MXM (Vallauris, France), SSSA (Pisa, Italy), IMTEK (Freiburg, Germany), UAB (Barcelona, Spain), UCBM (Roma, Italy), IUPUI (Indianapolis, USA).

8.3.2. Collaborations in European Programs, except FP7

- ÉGIDE, Partenariats Hubert Curien (PHC), Programme GALILEE (2011)
  Participants: Philippe Fraisse, Christine Azevedo Coste, Ahmed Chemori (LIRMM), Aurélio Capozzo (LABLAB, Roma, Italy), Claudia Mazza (LABLAB, Roma, Italy).
  Human locomotor and postural system mechanical parameter identification an dynamic and kinematic variables estimation.

8.4. International Initiatives

8.4.1. Japan-France Integrated Action Program "SAKURA and AYAME Junior"

Participant: Mitsuhiro Hayashibe.

"Modele Neuromusculaire du Corps Humain et ses Applications pour la Rehabilitation par la Stimulation Electrique Fonctionnelle", Funding for exchange supported by JSPS and INRIA 2010-2011.

8.4.2. INRIA Associate Teams

Title: @W ALK (Artificial Walking)

INRIA principal investigator: Philippe Fraisse

International Partner:
  Institution: Stanford University (United States)
  Laboratory: Artificial Intelligence Lab

Duration: 2010 - 2012

See also: http://www.lirmm.fr/~fraisse/@WALK/

The motivation approach is the complementary research works of these teams. Indeed, a collaborative project should give an additional value to their research results. On one hand, the DEMAR Project Team has experience in Functional Electrical Stimulation to restore or modulate movements on spinal cord injured patients and post stroke patients. In both pathologies researches on assisted gait using FES (for paraplegics with a walker and hemiplegics) are carried out in the team. On the other hand, the Robotics research group (Stanford) carries out manipulation tasks with a humanoid robot under equilibrium constraints. Within the framework of the previous collaboration, the crossed visits and seminars last year led us to work on two different directions: - FES muscle modeling in Opensim framework - Control mechanisms underlying age-related changes in motor control strategies during Sit-To-Stand.

8.4.3. INRIA International Partners

- Collaborative Research agreement on Academic Co-operation (contrat sans financement) "Neuromuscular function analysis and identification for Rehabilitation" Partner: University of Tokyo (Prof. Yoshihiko Nakamura) Duration: 2011 - 2014
6. Partnerships and Cooperations

6.1. National Initiatives


6.2. International Initiatives

6.2.1. Visits to International Partners

- V. Letort, at China Academy of Forestry (April, 2011)
- Y. Chen, at China Academy of Forestry (April, 2011)
- P.-H. Cournède, at Beihang University (April, 2011)
- B. Bayol, at Hanoi Univ. of Science and Technology (November, December, 2011)

6.2.2. Visits of International Scientists

- Sonia Malefaki (Univ. Patras) (July 2011)
- Katarina Smolenova (Univ. Goettingen) (June, September 2011)
- PhuongAnh Nguyen (Hanoi Univ. of Science and Technology) (December, 2011)

6.2.2.1. Internship

- Brenda Delamonicia (Smith College, USA) (March - July 2011)
- Octave Etard (Centrale Paris, Imperial College London) (March - July 2011)
8. Partnerships and Cooperations

8.1. Regional Initiatives

- Collaboration with the Immune Lab of Jacqueline Marvel in Lyon (Immunité, Infection et Virus), one paper published together in 2011.
- Our team is a partner of the recently accepted ANR project MODPOL (head Vincent Calvez, CNRS member of Inria Numed).

8.2. European Initiatives

- Collaboration with Oscar Angulo Torga, from the math department of the University of Valladolid (Spain), on the analysis of a age-structured model describing erythropoiesis, and its numerical resolution.

8.3. International Initiatives

8.3.1. INRIA International Partners

Two weeks of Thomas Lepoutre in Santiago (Chile) by Salome Martinez (CMM) for a joint work on cross diffusion models.
Programme explorateur: five weeks collaboration with Pr Doron Levy (College Park, Maryland, USA).

8.3.2. Visits of International Scientists

8.3.2.1. Internships

Vsevolod Salnikov (from May 2011 until Sep 2011)
  Subject: Hybrid models of cell population dynamics
  Institution: Laboratoire Poncelet (Russia (Russian Federation))

8.3.2.2. Visits of International Scientists

- Glenn Webb (June 2011)
  - Subject: Analysis of a model for transfer phenomena in biological populations
  - Institution: Vanderbilt University, Nashville, USA
- Marc Chaplain (24-25 November 2011)
  - Subject: Mathematical modelling of intracellular negative feedback systems
  - Institution: Division of Mathematics, University of Dundee, Scotland
- Grégoire Altan-Bonnet (16-17 November 2011)
  - Subject: Enforcing a reliable immune response with unreliable lymphocytes
  - Institution: ImmunoDynamics Group, Programs in Computational Biology and Immunology, Memorial Sloan-Kettering Cancer Center, New York NY, USA
• Marc-Thorsten Hutt (08-09 September 2011)
  – Subject: How few elements can systematically shape large-scale patterns
  – Institution: Jacobs University, Bremen, Germany

• Pal Westermark (22-23 June 2011)
  – Subject: Descriptive analysis of cellular circadian rhythms, and some scenarios for coupling and synchronization
  – Institution: Institute for Theoretical Biology, Berlin, Germany

• Philip Maini (25-27 May 2011)
  – Subject: Mathematical modelling of tumour dynamics
  – Institution: Oxford University, United Kingdom

• Ingmar Glauche (25-26 May 2011)
  – Subject: Systems biology of stem cell fate decisions
  – Institution: TU Dresden, Germany

• Peter Swain (04-05 December 2011)
  – Subject: Noise and fluctuations in gene expression
  – Institution: Center for Systems Biology at Edinburgh, United Kingdom

• Roeland M.H. Merks (29-30 March 2011)
  – Subject: Cell-based computer modeling of angiogenesis and vasculogenesis
  – Institution: Life Science Group, CWI, and NCSB-NISB, Amsterdam, The Netherlands

• Thomas Stiehl (02-03 March 2011)
  – Subject: A Mathematical Model for Cell Differentiation and its Applications to Hematopoiesis and Stem Cell Transplantation
  – Institution: Heidelberg University, Germany

8.3.3. Participation In International Programs

• Project PICS CNRS RUSSIE "Mathematical modelling of blood diseases", 2010-2012.
  **Participants**: Samuel Bernard, Fabien Crauste, Polina Kurbatova, Laurent Pujo-Menjouet, Vitaly Volpert [Coordinator].
5. Partnerships and Cooperations

5.1. National Initiatives


Agence Nationale de la Recherche ANR Fost (Formal proofs about Scientific computations), with EPI Proval from INRIA Saclay - Île-de-France, Laboratoire de Recherche en Informatique from University of Paris 11, and Laboratoire d’Informatique de l’Université Paris-Nord from University of Paris 13.

Agence Nationale de la Recherche ANR SHPCO2 (Simulation Haute Performance du Stockage Géologique de CO2) with IFP, LAGA laboratory from University Paris 13, École des Mines de St Etienne and BRGM.

5.2. International Initiatives

5.2.1. Visits of International Scientists

5.2.1.1. Invited scientists

Luca Formaggia (June 16-17), Politecnico di Milano (Italy)

5.2.1.2. Internships

Mohamed El Hedi Riahi (1/11 – 31/12 2011)

Subject: Estimation de paramètres hydrogéologiques
Institution: Ecole Nationale d’Ingénieurs de Tunis (Tunisia)

Fatma Cheikhk (1/11 – 31/12 2011)

Subject: Détermination de fractures dans un milieu poreux par la méthode du zoning
Institution: Ecole Nationale d’Ingénieurs de Tunis (Tunisia)

Alessio Fumagalli (from Jan 22 to Feb 23)

Subject: Numerical methods for flow and transport in porous media
Institution: Politecnico di Milano (Italy)

5.2.2. Participation in International Programs

Estime is associated with LIRNE-Equipe d’ingénierie mathématiques, université Ibn Tofaïl, Kenitra, Maroc (PHC Volubilis) in the project “Techniques multi-échelles adaptatives pour la résolution des problèmes d’écoulement et de transport en milieux poreux hétérogènes”. From 2010.
FLUMINANCE Project-Team (section vide)
8. Partnerships and Cooperations

8.1. Regional Initiatives

- **SubSample**: A chair proposal was submitted to DIGITEO in collaboration with the PARIETAL group (B. Thirion) from Pr. Dimitris Samaras (StonyBrook) aiming understanding correlations between imaging and gene expressions data. The proposal was accepted and Pr. Samaras will be spending for the next four years, three months per year at Ecole Centrale. In parallel a PhD student will be co-supervised between B. Thirion and D. Samaras.

- **sterEOS+**: MEDICEN excellence cluster supported a regional imitative towards the creation of the new generation clinical orthopedic work-station. This was a collaborative project consisting of EOS-Imaging (hardware provide/low dose X-ray Imaging), Global Imaging on Line (software provider - Picture archiving and communication system), the Arts et Métiers ParisTech (image-based biomechanical modeling), the GALEN group (medical image processing) and the leading clinical and university hospitals in the greater Paris area.

- **ADOC**: MEDICEN excellence cluster supported a regional imitative towards an imaging scanner providing guided diagnosis for cancer surgery. This translational research project will be conducted in collaboration between public partners (Inria, The Curie Institut and Hopital Tenon) and private companies (LLtech, Intrasense). A new imaging scanner allowing real time digital histology will be developed to assist the surgeon. The digital images will be used to give an indication to the surgeon, after a pathologist’ validation, on whether the surgical procedure shall be continued or stopped.

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7

Program: European Research Council  
Project acronym: DIOCLES  
Project title: Discrete bIOimaging perCeption for Longitudinal Organ modEling and computEr-aided diagnosiS  
Coordinator: N. Paragios

Abstract: Recent hardware developments from the medical device manufacturers have made possible non-invasive/in-vivo acquisition of anatomical and physiological measurements. One can cite numerous emerging modalities (e.g. PET, fMRI, DTI). The nature (3D/multi-phase/vectorial) and the volume of this data make impossible in practice their interpretation from humans. On the other hand, these modalities can be used for early screening, therapeutic strategies evaluation as well as evaluating bio-markers for drugs development. Despite enormous progress made on the field of biomedical image analysis still a huge gap exists between clinical research and clinical use. The aim of this proposal is three-fold. First we would like to introduce a novel biomedical image perception framework for clinical use towards disease screening and drug evaluation. Such a framework is expected to be modular (can be used in various clinical settings), computationally efficient (would not require specialized hardware), and can provide a quantitative and qualitative anatomo-pathological indices. Second, leverage progress made on the field of machine learning along with novel, efficient, compact representation of measurements toward computer aided diagnosis. Last, using these emerging multi-dimensional signals, we would like to perform longitudinal modeling and understanding the effects of aging to a number of organs and diseases that do not present pre-disease indicators such as...
brain neurological diseases, muscular diseases, certain forms of cancer, etc. Such a challenging and pioneering effort lies on the interface of medicine (clinical context), biomedical imaging (choice of signals/modalities), machine learning (manifold representations of heterogeneous multivariate variables), discrete optimization (computationally efficient inference of higher-order models), and biomedical image inference (measurements extraction and multi-modal data fusion of heterogeneous information sources). The expected results of such an approach are societal and scientific. The societal impact can be tremendous since we aim to provide novel means of using emerging biomedical signals to help physicians diagnose, select, customize and follow up therapeutic strategies for life-threatening diseases. Concerning scientific impact, this framework could influence and introduce novel means of re-thinking old, unsolved problems in a number of areas such us bioinformatics, geometric modeling, robotics, computer vision, multimedia, etc.

8.2.2. Major European Organizations with which you have followed Collaborations

Partner 1: Technical University of Munich, Chair for Computer Aided Medical Procedures & Augmented Reality - Computer Science Department (Germany)
Mono and Multi-modal image fusion using discrete optimization and efficient linear programming.

Partner 2: University of Crete, Computer Vision Group - Computer Science Department, (Greece)
Linear Programming, relaxations and efficient optimization of pair-wise and higher order Markov Random Fields.

Partner 3: Eidgenössische Technische Hochschule (ETH) - Zürich, Seminar für angewandte Mathematik - Mathematics Department, (Switzerland)
Sparse Representations and Optimal Linear Registration of Volumetric Medical Image Data.

8.3. International Initiatives

8.3.1. INRIA Associate Teams

Galen Team along with the Machine Learning Group (DAGS) of the Computer Science Department of Stanford University have proposed the creation of the SPLENDID — Self-Paced Learning for Exploiting Noisy, Diverse or Incomplete Data associate team. The proposal was among the ones accepted in the 2011 INRIA campaign.

8.3.2. INRIA International Partners

- **Department of Diagnostic Radiology, University of Pennsylvania:** The GALEN and the Section of Biomedical Image Analysis - SBIA group (Pr. C. Davatzikos) have an established collaboration during the past three years in the area of deformable image fusion. In this context, PhD candidates of the GALEN group spend time visiting the SBIA group, while Pr. Paragios participates at a National Institute Health grant led by SBIA. Such a collaboration led to a number of outstanding rank journal and conference publications [19].

- **Department of Computer Science, StonyBrook, State University of New York:** The GALEN and the Image Analysis Lab - CBL (Pr. D. Samaras) have an established collaboration during the past three years in the area of graph-based methods in medical imaging and computer vision. Pr. Samaras holds a research professor position (DIGITEO chair) at Ecole Centrale de Paris. Such a collaboration led to a number of outstanding rank conference publications during the last year [38], [32].

- **Department of Computer Science, University of Houston:** The GALEN and the Computational Biomedicine Lab - CBL (Pr. I. Kakadiaris) have an established collaboration during the past three years in the area of medical image segmentation and gene expressions imaging processing. Pr. Paragios holds a research professor position at the Computer Science Department of the University of Houston. Such a collaboration led to a number of outstanding rank conference publications [19] during the last year [36], [28].
• **Chang Gung Memorial Hospital – Linkou, Taiwan:** In the context of France-Taiwan program sponsored from the French Science Foundation, GALEN (in collaboration with the department of radiology of Henri Mondor University Hospital), a project (ADAMANTIUS) was initiated with the Chang Gung Memorial Hospital – Linkou that is the largest private hospital in Taiwan. The aim of the project is to study the Automatic Detection And characterization of residual Masses in patients with lymphomas through fusion of whole-body diffusion-weighted MRI on 3T and 18F-fluorodeoxyglucose PET/CT.

### 8.3.3. Visits of International Scientists

- **Rafeef Abugharbieh:** Jan-Jun. 2011, University of British Columbia - CA.
- **Ghassan Hamarneh:** Jan-Jun. 2011, Simon Fraser University - CA.
- **Dimitris Samaras:** Oct. 2011, State University of New York - StonyBrook, US.

#### 8.3.3.1. Internship

- **Avinash Singh Bagri:** Indian Institute of Technology - New Delhi, IN - Message Passing Methods on Graphics Processing Units towards Real-time Deformable Image Fusion.
- **Krishna Nand Keshava Murthy:** University of British Columbia, CA - Iconic/Geometric Deformable Registration of Diffusion Tensor Images.
- **Thanos Papadopoulos:** Technical University of Athens, GR - Iconic/Geometric Atlas-based Segmentation of Liver Volumetric Images.
- **Jose Carlos Rubio:** Universitat Autònoma de Barcelona, ES - HyperGraph Representations and Matching towards Scene Understanding.
- **Stavros Tsogkas:** Technical University of Athens, GR - Learning-based Symmetry Detection.
IBIS Project-Team

7. Partnerships and Cooperations

7.1. National projects

<table>
<thead>
<tr>
<th>Project name</th>
<th>ColAge – Lifespan control in bacteria: Natural and engineering solutions</th>
</tr>
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<tbody>
<tr>
<td>Coordinator</td>
<td>H. Berry</td>
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<tr>
<td>IBIS participants</td>
<td>G. Baptist, E. Cinquemani, J. Geiselmann, H. de Jong, J. Izard, S. Lacour, C. Pinel, D. Ropers</td>
</tr>
<tr>
<td>Type</td>
<td>Action d’Envergure INRIA-INSERM (2008-2012)</td>
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<td>Web page</td>
<td><a href="http://colage.saclay.inria.fr">http://colage.saclay.inria.fr</a></td>
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<table>
<thead>
<tr>
<th>Project name</th>
<th>GeMCo – Model reduction, experimental validation, and control for the gene expression machinery in E. coli</th>
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<tbody>
<tr>
<td>Coordinator</td>
<td>M. Chaves</td>
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<tr>
<td>IBIS participants</td>
<td>G. Baptist, E. Cinquemani, J. Geiselmann, H. de Jong, J. Izard, S. Lacour, C. Pinel, D. Ropers</td>
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<td>Type</td>
<td>ANR Blanc (2010-2013)</td>
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<tr>
<th>Project name</th>
<th>Identification structurelle et paramétrique des réseaux de régulation bactériens</th>
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<tr>
<td>Coordinator</td>
<td>E. Cinquemani</td>
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<tr>
<th>Project name</th>
<th>Motilité ou adhésion : comment les entérobactéries choisissent entre ces deux états physiologiques déterminants pour la virulence</th>
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<tbody>
<tr>
<td>Coordinator</td>
<td>S. Lacour</td>
</tr>
<tr>
<td>IBIS participants</td>
<td>J. Demol, O. Dudin, J. Geiselmann, J. Izard, S. Lacour, C. Pinel</td>
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<tr>
<td>Type</td>
<td>Grant, Cluster Infectiologie, Région Rhône-Alpes</td>
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<tr>
<td>Web page</td>
<td><a href="http://cluster-infectiologie.fr/">http://cluster-infectiologie.fr/</a></td>
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<tr>
<th>Project name</th>
<th>Séminaire grenoblois des systèmes complexes</th>
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<tbody>
<tr>
<td>Coordinators</td>
<td>S. Achard, O. François, A. Girard, E. Prados, S. Rafai, D. Ropers</td>
</tr>
<tr>
<td>IBIS participants</td>
<td>D. Ropers</td>
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<td>Type</td>
<td>Funding by Institut des Systèmes Complexes de Lyon (IXXI)</td>
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<tr>
<th>Project name</th>
<th>Séminaire de modélisation du vivant</th>
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<tr>
<td>Coordinators</td>
<td>O. Gandrillon</td>
</tr>
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<td>IBIS participants</td>
<td>D. Ropers</td>
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<td>Type</td>
<td>Funding by GdR BIM</td>
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### 7.2. International projects

<table>
<thead>
<tr>
<th>Project name</th>
<th>French bioinformatics contribution to ICGC</th>
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<tbody>
<tr>
<td>Coordinator</td>
<td>G. Thomas</td>
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<tr>
<td>IBIS participants</td>
<td>F. Rechenmann</td>
</tr>
<tr>
<td>Type</td>
<td>International Cancer Genome Consortium (ICGC)</td>
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<tr>
<td>Web page</td>
<td><a href="http://www.icgc.org/">http://www.icgc.org/</a></td>
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The goal of ICGC (International Cancer Genome Consortium) is to obtain a comprehensive description of genomic, transcriptomic and epigenomic changes in 50 different cancer types. In France, INCa (French National Cancer Institute) contributes to this project and focuses on two types of cancer. The main idea is to sequence the human genome of normal and tumoral cells of a large set of patients and to compare these genomic sequences to identify the mutations which may explain the development of the cancers. Bioinformatics is clearly involved in the management, the analysis and the visualization of the huge sets of data and results. Bioinformatics of the French contribution is carried out at Lyon, in the context of the Synergie Lyon Cancer Foundation. François Rechenmann has joined this bioinformatics team and contributes to the organization of the data management and analysis workflow, under the leadership of prof. Gilles Thomas.

### 7.3. International collaborations

IBIS has strong collaborations with the group of Giancarlo Ferrari-Trecate at the Computer Engineering & Systems Science Department of the University of Pavia (Italy) and the group of John Lygeros at the Automatic Control Lab at ETH Zürich (Switzerland). This collaboration started with the FP6 project Hygeia, in which the above groups and IBIS (then HELIX) participated. Over the years, it has resulted in a dozen of co-authored papers and the co-supervision of a PhD thesis by Hidde de Jong and Giancarlo Ferrari-Trecate. Eugenio Cinquemani was a post-doctoral fellow at ETH in the framework of the Hygeia project, and joined the IBIS group as a research scientist in the fall of 2009.
7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Epsilon

The Epsilon project is an ANR project entitled “Domain decomposition and multi-scale computations of singularities in mechanical structures”. The members are Ecole Polytechnique, I3m at Montpellier, Laga at Paris-Nord and INRIA. INRIA is particularly involved in the modeling and simulation of an assembly of structures containing a very thin layer embedded in a 3D structure. This is the subject of the PhD thesis of Sofiene Hendili (co-supervised by Montpellier and INRIA).

7.1.2. DISCO

DISCO² (du DIScret au COntinu pour les polymères réticulés) is an INRIA ARC. The members are EPI SIMPAF (Antoine Gloria) and MACS (Maya de Buhan and Marina Vidrascu) from INRIA, Ecole polytechnique, ESPCI, and the Max Planck Institute for Mathematics in the Sciences (Leipzig). The leader is Antoine Gloria (EPI SIMPAF). The main objective is the design, mathematical analysis, numerical analysis, and numerical simulation of discrete models for rubber. A workshop was organized in January 2011.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. euHeart

Title: euHeart
Type: COOPERATION (ICT)
Defi: Virtual Physiological Human
Instrument: Integrated Project (IP)
Duration: June 2008 – May 2012
Coordinator: Philips Technologie GmbH Forschungslaboratorien (Germany)
Others partners: Univ. Oxford, Universitat Pompeu Fabra (Barcelona), Univ. Sheffield (UK), King’s College London, Academic Medical Center (Amsterdam), Univ. Karlsruhe, INSERM, Philips Medical Systems, Berlin Heart, Hemolab (Eindhoven), Deutsche Krebsforschungszentrum Heidelberg, Volcano Europe (Brussels), Boston Scientific (Spain), Hospital Clínico San Carlos de Madrid
See also: http://www.euheart.eu/
Abstract: The euHeart Project is a European FP7 project of the IP category. It combines seventeen industrial, clinical and academic partners, whose collective goal is the development of individualized, computer-based, human heart models. Using comprehensive, patient-specific data as the basis for their design, these models will provide insight into the origin and progression of specific disease patterns, including those associated with heart failure, heart rhythm disorders, coronary artery disease, and aortic disease. Within this project, the Macs team is more specifically in charge of coordinating one workpackage entitled “Biophysical model personalisation”, which consists in developing some methodological and software tools to solve the inverse problems of concern in the applications considered in the project.

7.2.1.2. VPH-Share

http://chercheurs.lille.inria.fr/~gloria/DISCO.html
Title: VPH-Share
Type: COOPERATION (ICT)
Defi: Virtual Physiological Human
Instrument: Integrated Project (IP)
Duration: March 2011 – February 2015
Coordinator: Univ. Sheffield (UK)
Others partners: Cyfronet (Cracow), University College London, Istituto Ortopedico Rizzoli (Bologna), NHS, IBM Israel, Univ. Auckland, Agència d’Informació, Avaluació i Qualitat en Salut (Barcelona), Biocomputing Competence Centre (Milano), Universitat Pompeu Fabra (Barcelona), Philips Research, TUE (Eindhoven), Sheffield Teaching Hospitals, Atos Origin (Madrid), the Open University (UK), Univ. Vienna, King’s College London, Empirica (Bonn), Fundació Clínic (Barcelona), Univ. Amsterdam
See also: http://vph-share.org/

Abstract: VPH-Share aims at developing the organisational fabric (the infostructure) and integrate the optimised services to expose and share data and knowledge, to jointly develop multiscale models for the composition of new VPH workflows, and to facilitate collaborations within the VPH community. Within this project, the Macs team is in charge of developing some high-performance data assimilation software tools.

7.3. International Initiatives

7.3.1. INRIA Associated Teams

7.3.1.1. CARDIO

Title: Mathematical modelling and Numerical Simulation for Cardiovascular Applications
INRIA principal investigator: Philippe Moireau
International Partner:
  Institution: Stanford University (United States)
  Laboratory: Bioengineering and Surgery Departments
  Researcher: Charles TAYLOR

International Partner:
  Institution: UC San Diego (United States)
  Laboratory: Mechanical and Aerospace Engineering
  Researcher: Alison MARSDEN

Duration: 2011–2013
See also: https://idal-siege.inria.fr/cardio/

To improve disease understanding, surgical repair or medical device design, mathematical and numerical tools have been the subject of much efforts over the last decades. In this context, we propose a research subject on cardiovascular and air flow modeling. It extends the project of the previous associated team on blood flow modeling to flow of air in the lungs. The goal is to continue to work on bringing together methods developed in the different teams, to compare them if necessary, and to apply them to in-vivo (animal or human) physiologically relevant situations. All the different team members have a strong will to work close to the applications. They all have links to clinicians or biologists, which drive the concrete applications that will be studied: congenital heart disease pathophysiology and repair, artery wall compliance study in normal and pathophysiological cases, heart valve pathophysiology assessment, aerosol deposition in the lungs. Furthermore, the associated team facilitates the breadth of researcher knowledge by exposure to different ways of thinking, methods and/or applications, and by the training of students as they interact with the other institutes.
8. Partnerships and Cooperations

8.1. Regional Initiatives

The PhD fellowship of Elodie Estecahandy is partially (50%) financed by the Conseil Régional d’Aquitaine. The PhD fellowship of Vanessa Mattesi is partially (50%) financed by the Conseil Régional d’Aquitaine. The PhD fellowship of Cyril Agut is financed by the Conseil Général des Pyrénées Atlantiques.

8.2. National Initiatives

ANR AHPI The endeavour of this project is to develop some methodology for modelling and solving certain inverse problems using tools from harmonic and complex analysis. These problems pertain to deconvolution issues, identification of fractal dimension for Gaussian fields, and free boundary problems for propagation and diffusion phenomena. The target applications concern radar detection, clinical investigation of the human body (e.g. to diagnose osteoporosis from X-rays or epileptic foci from electro/magneto encephalography), seismology, and the computation of free boundaries of plasmas subject to magnetic confinement in a tokamak. Such applications share as a common feature that they can be modeled through measurements of some transform (Fourier, Fourier-Wigner, Riesz) of an initial signal. Its non-local character generates various uncertainty principles that make all of these problems ill-posed. The techniques of harmonic analysis, as developed in each case below, form the thread and the mathematical core of the proposal. They are intended, by and large, to regularize the inverse issues under consideration and to set up constructive algorithms on structured models. These should be used to initialize numerical techniques based on optimization, which are more flexible for modelling but computationally heavy and whose convergence often require a good initial guess. In this context, the development of wavelet analysis in electrical engineering, as well as signal and image processing or singularity detection, during the last twenty years, may serve as an example. However, many other aspects of Fourier analysis are at work in various scientific fields. We believe there is a strong need to develop this interaction that will enrich both Fourier analysis itself and its fields of application, all the more than in France the scientific communities may be more separate than in some other countries.

The project was created in July 2007. Meetings were organized twice a year, alternatively in Orléans, Bordeaux, Sophia and Pau. Collaborations have begun with the Bordeaux team on the use of bandelet formalism for the seismic inversion and a post-doc, hired in October 2008, had in charge to analyze with us the feasibility of this approach. We have worked on the approximation of seismic propagators involving Fourier integral operators by considering different approaches. From November 2010 to November 2011, we have hired an associate engineer who has worked with us on the development of a software for the gravimetric inversion.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Joint project with BCAM (Basque Center of Applied Mathematics) funded by the Conseil Régional d’Aquitaine and the Basque Government in the framework of the Aquitaine-Euskadi Call. Total Amount: 14 000 euros.

Program: Fonds commun de coopération Aquitaine/Euskadi
Project acronym: AKELARRE
Project title: Méthodes numériques innovantes et logiciels performants pour la simulation de la propagation des ondes électromagnétiques en milieux complexes
Duration: février 2011 - février 2013
Coordinator: Hélène Barucq
Other partners: BCAM (Basque Center of Applied Mathematics), Spain
Abstract: This project brings together the complementary skills in the field of wave propagation of two research teams which are respectively located in Pau and Bilbao. The main objective of this collaboration is to develop innovative numerical methods and to implement powerful software for the simulation of electromagnetic waves in complex media. These waves play an important role in many industrial applications and the development of such software is of great interest for many industrial enterprises located in the region. Theoretical and practical issues are considered. In particular, we focus on the mathematical analysis of boundary conditions that play a crucial role for accurate numerical simulations of waves.

8.4. International Initiatives

8.4.1. INRIA Associate Teams

8.4.1.1. MAGIC

Title: Advance Modelling in Geophysics
INRIA principal investigator: Hélène Barucq
International Partner:
Institution: California State University at Northridge (United States)
Laboratory: Department of Mathematics
Duration: 2006 - 2011
See also: http://uppa-inria.univ-pau.fr/m3d/Equipe-associee/index.html
The main objective of this three-year research program is the design of an efficient solution methodology for solving Helmholtz problems in heterogeneous domains, a key step for solving the inversion in complex tectonics. The proposed research program is based upon the following four pillars:
1. The design, implementation, and the performance assessment of a new hybrid mixed type method (HMM) for solving Helmholtz problems.
2. The construction of local nonreflecting boundary conditions to equip HMM when solving exterior high-frequency Helmholtz problems.
3. The design of an efficient numerical procedure for full-aperture reconstruction of the acoustic far-field pattern (FFP) when measured in a limited aperture.
4. The characterization of the Fret derivative of the elasto-acoustic scattered field with respect to the shape of a given elastic scatterer.

8.4.2. Visits of International Scientists

- Chokri Bekkey spent one week in MAGIQUE-3D in April 2011.
- Yingxiang Xu, Post-doctoral student at Genova University, spent one week in MAGIQUE-3D in May 2011.
- Robert Kotiuga, Professor at Boston University, spent one month as invited Professor in MAGIQUE-3D in September 2011.
- Mounir Tlemcani spent two weeks in MAGIQUE-3D in September 2011.
- Mohamed Lakhdar Hadji (University of Annaba, Algeria) spent one month in MAGIQUE-3D in December 2011.
- Jewoo Yoo, PhD student at Seoul University (Korea), is visiting us from October 2011 to February 2012.

In the framework of the Aquitaine/Euskadi programm, four scientists from the BCAM visited Magique 3D:
- Alejandro Pozo, PhD student, spent two weeks in MAGIQUE-3D in October 2011.
- Cristi Cazacu, PhD student, spent two weeks in MAGIQUE-3D in October 2011.
- Aurora Marica, Post-Doctoral student, spent one week in MAGIQUE-3D in November 2011.
- Javier Escartin, PhD student, spent two weeks in MAGIQUE-3D in December 2011.
8.4.3. Participation In International Programs

Depth Imaging Partnership Magique-3D maintains active collaborations with Total. In the context of depth imaging and with the collaboration of Henri Calandra from Total, Magique-3D coordinates research activities dealing with the development of high-performance numerical methods for solving wave equations in complex media. This project involves French academic researchers in mathematics, computing and in geophysics, and is funded by Total. At the end of 2011, four PhD students have defended their PhD dealing with contributions to new numerical imaging methods that are based on the solution of the full wave equation. Two were working in Magique-3D and in November 2011, a Ph.D. student has been hired in Magique-3D. Moreover, four internships have been realized in Magique3D. Always in the framework of DIP, Magique-3D has started a collaboration with Prof. Changsoo Shin who is an expert of Geophysics and works at the Department of Energy resources engineering (College of Engineering, Seoul National University). At that moment, Jewoo Yoo, who is a first year PhD student advised by Prof. Changsoo Shin, is visiting Magique-3D during four months. To our knowledge, this network is the first in the French research community to establish links between industrial and academic researchers in the context of a long-term research program managed by an INRIA team.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Aquitaine Region “SAGÉSS” comparative genomics for wine starters

Participants: David James Sherman [correspondant], Pascal Durrens, Elisabeth Bon, Tiphaine Martin, Nicolás Loira.

This project is a collaboration between the company SARCO, specialized in the selection of industrial yeasts with distinct technological abilities, with the ISVV and MAGNOME. The goal is to use genome analysis to identify molecular markers responsible for different physiological capabilities, as a tool for selecting yeasts and bacteria for wine fermentation through efficient hybridization and selection strategies. This collaboration has obtained the INNOVIN label.


Participants: David James Sherman [correspondant], Elisabeth Bon.

8.2. National Initiatives

8.2.1. ANR DIVOENI, 2008-2012

Participants: Elisabeth Bon [correspondant], Aurélie Goulielmakis.

Elisabeth Bon is a partner in DIVOENI, a four-year ANR project concerning intraspecies biodiversity of the oenological bacteria *Oenococcus oeni*. Coordinated by Prof. Aline Lonvaud (Univ. Bordeaux Segalen) from the Institute of Vine and Wine Sciences of Bordeaux – Aquitaine, this scientific programme was developed:

1. To evaluate the genetic diversity of a vast collection of strains, to set up phylogenetic groups, then to investigate relationships between the ecological niches (cider, wine, champagne) and the essential phenotypical traits. Hypotheses on the evolution in the species and on the genetic stability of strains will be drawn.
2. To propose methods based on molecular markers to make a better use of the diversity of the species.
3. To measure the impact of the repeated use of selected strains on the diversity in the ecosystem and to draw the conclusions for its preservation.

Elisabeth is in charge of the computational infrastructure dedicated to genomics and post-genomics data storage, handling and analysis. She coordinates collaboration with the CBiB-Centre de Bioinformatique de Bordeaux.

8.3. European Initiatives

8.3.1. Affinity Proteomics (FP7)

Participants: David James Sherman [correspondant], Natalia Golenetskaya.

A major objective of the “post-genome” era is to detect, quantify and characterise all relevant human proteins in tissues and fluids in health and disease. This effort requires a comprehensive, characterised and standardised collection of specific ligand binding reagents, including antibodies, the most widely used such reagents, as well as novel protein scaffolds and nucleic acid aptamers. Currently there is no pan-European platform to coordinate systematic development, resource management and quality control for these important reagents.
MAGNOME is an associate partner of the FP7 “Affinity Proteome” project coordinated by Prof. Mike Taussig of the Babraham Institute and Cambridge University. Within the consortium, we participate in defining community for data representation and exchange, and evaluate knowledge engineering tools for affinity proteomics data.

8.3.2. Sustained Collaborations with Major European Organization

- **Prof. Mike Taussig**: Babraham Institute & Cambridge University
  - Knowledge engineering for Affinity Proteomics

- **Henning Hermjakob**: European Bioinformatics Institute
  - Standards and databases for molecular interactions

8.4. International Initiatives

8.4.1. Visits of International Scientists

**Participants:** Vsevolod Makeev, Artëm Kasianov, Marie Llubères.

Vsevolod Makeev (Senior Researcher at the Russian Academy of Sciences, Vavilov Institute) has been a collaborator for several years. He and his student Artëm Kasianov made several visits to Inria in 2011, and worked with us on genome assembly algorithms, computational identification of sequence motifs, and distributed algorithms for data mining. Vsevolod Makeev was a visiting CNRS Senior Researcher in the LaBRI and MAGNOME for three months in the Fall of 2011.

Marie Llubères visited MAGNOME from the University of Puerto Rico for two months on a grant from the NSF PIRE program. She worked on hierarchical modeling of biological systems and specifically on bijections between Probabilistic Boolean Networks and the Stochastic Transition Systems used in the BioRica framework.

8.4.1.1. Internship

**Participant:** Hugo Campbell Sills.

Hugo Campbell Sills came to MAGNOME on an Inria International Internship in the Summer of 2011, and worked on single-nucleotide polymorphism discovery and effects in twelve œnological yeast genomes.

8.4.2. Participation In International Programs

8.4.2.1. Généolevures and Dikaryome Consortia

**Participants:** David James Sherman [correspondant], Pascal Durrens, Tiphaine Martin, Nicolás Loira, Anasua Sarkar, Anna Zhukova, Florian Lajus.

Since 2000 our team is a member of the Généolevures Consortium (GDR CNRS), a large-scale comparative genomics project that aims to address fundamental questions of molecular evolution through the sequencing and the comparison of 14 species of hemiascomycetous yeasts. The Consortium is comprised of 16 partners, in France, Belgium, Spain, the Netherlands (see [http://genolevures.org/](http://genolevures.org/)). Within the Consortium, our team is responsible for bioinformatics, for research in new methods of analysis. Pascal Durrens and Tiphaine Martin of the CNRS are responsible for the development of resources for exploiting comparative genomic data. Pascal Durrens is the editorial manager of the Généolevures on-line resource.

The Dikaryome Consortium is a scientific collaboration between several international partners and the National Center for Sequencing (CEA–Génoscope, Évry) on the sequencing, annotation, and comparative analysis of fungal genomes.

These perennial collaborations continue in two ways. First, a number of new projects are underway, concerning several new genomes currently being sequenced, and new questions about the mechanisms of gene formation. Second, through the development and improvement of the Généolevures On Line database, in whose maintenance our team has a longstanding commitment.
MASAIE Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

MASAIE has obtained a grant from Région Lorraine for a research project: “Dynamique des populations de pathogènes”.

7.2. International Initiatives

7.2.1. Participation In International Programs

MASAIE is involved in a cooperation program with Brazil. This project, funded by CAPES-COFECUB, “new methods in epidemiology and early detection of events” for 4 years, has begun in January 2011.

A. Iggidr and G. Sallet have spent 3 weeks in Brazil and M-L Penna (UFF) and M. De Souza (UFF) has visited MASAIE in 2011. This program includes Federal University Fluminense (Rio), Unicam (Caminas), UPFE (Recife), Foundation Fiocruz (Brazilian Ministry of Health), Foundation Getulio Vargas and IMPA. A research program on dengue has been established and a common paper is under writing. The common research team is constituted half by mathematicians and computer scientist and half by public health researchers.

7.2.1.1. EPLS

MASAIE has developed a cooperation with Pasteur Institute and EPLS to model Bilharzia on Senegal river basin.
MODEMIC Team

8. Partnerships and Cooperations

8.1. International Initiatives

8.1.1. Associated team DYMECOS

Participants: Fabien Campillo, Jérôme Harmand, Claude Lobry, Alain Rapaport, Tewfik Sari, Terence Bayen.

DYMECOS is an associated team with Chile, mainly with CMM (Centro de Modelamiento Matemático), Univ. de Chile, Santiago, DIM (Departamento de Ingeniería Matemática), Universidad de Chile, Santiago and Departamento de Matematica, Universidad Tecnica Federico Santa Maria (UTFSM).

Two kinds of investigations have been conducted:

- minimal time control problems of fedbatch processes with several species, and optimal strategies for the bioremediation of natural water resources,
- stochastic modelling of the chemostat.

In 2011, the team has been visited by the Chilean researchers D. Jeson (U. Frontera), P. Gajardo (UTFSM, Valparaiso), H. Ramirez (DIM, Santiago) and G. Ruiz (PUCV, Valparaiso). Two Chilean students V. Riquelme and E. Tapia have spent some time in MODEMIC team, and two PhD students J. Fernandez and M. Sebbah have been sent to Chile.

A second Franco-Chilean Workshop on Bioprocess Modelling, co-organized with the Chilean partners, is scheduled in January at Pucón. The workshop gathers mathematicians, process engineers and micro-biologists. Activities and results are described on the web site Eadymecos.

8.1.2. MOMARE

Participants: Fabien Campillo, Jérôme Harmand, Marc Joannides, Claude Lobry, Alain Rapaport, Tewfik Sari.

The MODEMIC Project-Team is coordinator of the Stic-Amsud project MOMARE “Mathematical models of natural resources management” between INRIA, IMCA (Peru), DIM-CMM (Chile) and PLAMEDA (Argentina). This project has funded the travel of researchers from France to South America and from South America to France. In this context, the MODEMIC Project-Team was visited by E. Ocana (IMCA), H. Ramirez-Cabrera (DIM-CMM), J. Fontbona (DIM-CMM). The project is structured in two subthemes: “microbiology” (bioreactors, waste water treatment) and “harvesting” (“fishery” and “forestry”, but also “mines”). The project will be ended at the second French-Chilean Workshop on Bioprocess Modelling January 16-17, 2012 (Pucón, Chile).

8.1.3. TREASURE

Participants: Jérôme Harmand, Claude Lobry, Tewfik Sari.

The TREASURE network benefits from financial support from INRIA, INRA and African partners of about 20 Keuros/year for three years (2009-2011). In addition, a European IRSES (called COADVISE) project ending in 2012 includes 42 man months available for exchanging PhD and postdoc students within 48 months.

This project was recently extended in a renewed form for a period of four years from January 2012.

8.1.4. LIRIMA Stic-Mada

Participants: Fabien Campillo, Angelo Raherinirina.

The MODEMIC Project-Team is coordinator of the LIRIMA/Stic-Mada project for the theme: modelling and management of natural resources. The thesis of Angelo Raherinirina is prepared in this context in association with the University of Fianarantsoa and IRD. In Antananarivo (Madagascar), September 19-30, we organized the first “Ecole Mathématique Africaine” together with the CIMPA. One of the themes of this school was on Markov modelling for ecological successions.
8. Partnerships and Cooperations

8.1. Regional Initiatives

- Nicolas Papadakis is responsible of the ASIOME project (Assimilation de Structures d’Images Océanographiques et Modélisation d’Erreurs) funded by the Pôle Mathématiques Sciences et Technologies de l’Information et de la Communication (MSTIC) of the Joseph Fourier University, Grenoble. 6.4.2
- E.Blayo, M. Nodet are responsible for the workpackage "numerical modelling" within the regional project (Région Rhône-Alpes) Envirhonalp http://www.envirhonalp.fr.
- A. Rousseau leads the working group Couplage Fluide/Vivant in Montpellier for the study of coupled systems (fluid dynamics and life sciences) in nearshore regions. This research is funded by the Labex NUMEV in Montpellier.
- E. Blayo is a member of the scientific committee of the regional Institut des Sciences Complexes (IXXI) http://www.ixxi.fr.
- E. Blayo is a member of the scientific committee of the Pôle Alpin Risques Naturels http://www.risknat.org.

8.1.1. Collaborations with Various Regional Research Teams

- LGGE Grenoble, Edge team (C. Ritz, O. Gagliardini, F. Gillet-Chaulet), see paragraphs 6.6.2 and 6.6.3.
- LEGI, MEOM team: 6.4.2, 6.1.2, 6.2.3, 6.3.1, 6.4.1.
- LTHE: 6.5.2, 6.5.3

8.2. National Initiatives

8.2.1. Interactions with other INRIA Project-Teams or Actions

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<tr>
<td>A. Vidard</td>
<td>Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique (Toulouse), Mercator-Océan (Toulouse), Laboratoire de Physique des Océans (Brest),</td>
<td>Ocean Data Assimilation</td>
<td>6.3.1</td>
</tr>
<tr>
<td>A. Vidard</td>
<td>LOCEAN (Paris)</td>
<td>Ocean Adjoint Modelling</td>
<td>6.3.1</td>
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<tr>
<td>A. Vidard</td>
<td>LPO (Brest), CERFACS</td>
<td>Ocean data assimilation</td>
<td>6.3.1</td>
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8.2.3. MOISE team is implied in:

- A 4-year ANR contract: ANR ADAGe (Adjoint ice flow models for Data Assimilation in Glaciology, see paragraph 6.6).
- A 4-year ANR contract: ANR Geo-FLUIDS (Fluid flows analysis and simulation from image sequences: application to the study of geophysical flows, see paragraph 6.4).
- A 4-year ANR contract: ANR TOMMI (Transport Optimal et Modèles Multiphysiques de l’Image), see paragraphs 6.7.2, 6.4.
- AST & Risk ANR project (white project selected in 2008). http://isfaserveur.univ-lyon1.fr/asterisk/
• A 3 years ANR contract: ANR MSDAG (Multiscale Data Assimilation in Geophysics) see paragraph 6.2.4.


• Nicolas Papadakis is involved in the SWOT-Ocean group in charge of the use of the high resolution data that will be provided by the future SWOT satellite (CNES/NASA mission). This work is realized in collaboration with Jacques Veron of the Laboratoire des Écoulements Géophysique et Industriels. 6.4.2

• M. Nodet is PI of the project "Méthodes inverses en glaciologie" supported by INSU-LEFE.

• A. Vidard leads a group of projects gathering multiple partners in France and UK on the topic "Variational Data Assimilation for the NEMO/OPA9 Ocean Model", see 6.3.1. This project is granted by two INSU-LEFE and a Mercator-Ocean calls for proposals.

• A. Vidard is coordinator of the ANR VODA (Variational Ocean Data Assimilation for multi-scales applications) 4-year contract.

• DATICE simulations are currently performed at LSCE (Laboratoire des Sciences de l’Environnement et du Climat) in the framework of a PhD thesis (Lucie Bazin supervised by Amaelle Landais), and at LGGE (Laboratoire de Glaciologie et de Géophysique de l’Environnement) in the framework of a postdoctoral work (Daniel Véres, supervised by Patricia Martinerie). Both works will contribute to calculate AICC2012, the future unified Antarctic ice core age scales (Special Issue in preparation in the Climate of the Past journal, Eric Wolff, CP co-editor-in-chief, British Antarctic Survey, Cambridge). An ANR proposal in preparation "Datation multi-archives" (where LGGE and LSCE are partners, and MOISE members intervene as experts) aims in particular at extending the mathematical method to marine sediment cores.

• E. Blayo is the co-chair (with M. Bocquet, EPI CLIME) of the CNRS-INSU research program on mathematical and numerical methods for ocean and atmosphere LEFE-MANU. http://www.insu.cnrs.fr/co/lef

• E. Blayo was a member of the 2011 ANR evaluation panel "Earth, Environment, Space".

• L. Debreu is the coordinator of the national group COMODO (Numerical Models in Oceanography)

• L. Debreu organized a 3-day meeting on numerical ocean modelling (Villard de Lans, November 2011)

### 8.2.4. Participation to National Research Groups (GdR) CNRS

• M. Nodet is involved in GDR Calcul and GDR Ondes.


### 8.3. European Initiatives

#### 8.3.1. Major European Organizations with which Moise has followed Collaborations

Partner: European Centre for Medium Range Weather Forecast. Reading (UK)

World leading Numerical Weather Centre, that include an ocean analysis section in order to provide ocean initial condition fo the coupled ocean atmosphere forecast. They play a significant role in the NEMOVAR project in which we are also partner.

We do have a strong collaboration with their ocean initialization team through both our NEMO, NEMO-ASSIM and NEMOVAR activities. They also are our partner in the NEMOVAR consortium.


We have a long term collaboration about data assimilation with the Black Sea. This collaboration is getting to a new level with their plan to adopt NEMO and NEMOVAR for their operational forecasting system. On our side, we will benefit from their expertise on the Black Sea dynamics, that is an excellent test case for our developments and methods.

Partners: David Vaughan, British Antarctic Survey (UK). Tony Payne, University of Bristol (UK)
Subject: Ice-sheet inverse modelling to assess sea-level change.

Partners: V. Shutyaev (Institute of Numerical Mathematics, Russian Academy of Sciences), I. Gejadze (Dept. of Civil Engineering, University of Strathclyde, Scotland)
Subject: propagation and control of the error in data assimilation and on evaluation of error covariance by deterministic method.

Partner: GDR-E CONEDP
Subject: Control of Partial Differential Equations.

Partner: Vicent Caselles of the Pompeu Fabra University, Barcelona Spain
Subject: Image processing problems such as 3D reconstruction [13], histogram transfer [15] or image inpainting [29].

8.4. International Initiatives

- C. Prieur collaborates with Antonio Galves (University Sao Paulo) and Jose R. Leon (UCV, Central University of Caracas). She is a member of a USP-COFECUB project on the study of stochastic models with variable length memory (2010-2013) with University of Sao Paulo.
- F.-X. Le Dimet was invited in Jet Propulsion Laboratory, NASA, Pasadena, USA, 1 week, (1 conference)
- F.-X. Le Dimet was invited in CICESE, Ensenada Mexique 2 weeks, février 2011 (2 conférences)
- F.-X. Le Dimet was invited in Ewu University, Seoul Korea, August 2011, 2 weeks.
- F.-X. Le Dimet was invited in Florida State University : 6 weeks.
- F.-X. Le Dimet was invited in Caltech, Pasadena, California 1 week, 1 conference.
- F.-X. Le Dimet was invited in NASA (JPL) 1 week.

8.4.1. Visits of International Scientists

- Professor Robert Miller (College of Oceanic and Atmospheric Sciences, Oregon State University) has been visiting our team from October 2010 to September 2011. He worked in particular with us on Ensemble Kalman filtering and on error filtering in variational data assimilation.
6. Partnerships and Cooperations

6.1. European Initiatives

6.1.1. FP7 Projects

6.1.1.1. BRAINSCALES

Title: BrainScaleS: Brain-inspired multiscale computation in neuromorphic hybrid systems
Type: COOPERATION (ICT)
Defi: Brain-inspired multiscale computation in neuromorphic hybrid systems
Instrument: Integrated Project (IP)
Duration: January 2011 - December 2014
Coordinator: Universitaet Ruprecht- Karls Heidelberg (Germany)
See also: http://brainscales.kip.uni-heidelberg.de/

Abstract: The BrainScaleS project aims at understanding function and interaction of multiple spatial and temporal scales in brain information processing. The fundamentally new approach of BrainScaleS lies in the in-vivo biological experimentation and computational analysis. Spatial scales range from individual neurons over larger neuron populations to entire functional brain areas. Temporal scales range from milliseconds relevant for event based plasticity mechanisms to hours or days relevant for learning and development. In the project generic theoretical principles will be extracted to enable an artificial synthesis of cortical-like cognitive skills. Both, numerical simulations on petaflop supercomputers and a fundamentally different non-von Neumann hardware architecture will be employed for this purpose. Neurobiological data from the early perceptual visual and somatosensory systems will be combined with data from specifically targeted higher cortical areas. Functional databases as well as novel project-specific experimental tools and protocols will be developed and used. New theoretical concepts and methods will be developed for understanding the computational role of the complex multi-scale dynamics of neural systems in-vivo. Innovative in-vivo experiments will be carried out to guide this analytical understanding. Multiscale architectures will be synthesized into a non-von Neumann computing device realised in custom designed electronic hardware. The proposed Hybrid Multiscale Computing Facility (HMF) combines microscopic neuromorphic physical model circuits with numerically calculated mesoscopic and macroscopic functional units and a virtual environment providing sensory, decision-making and motor interfaces. The project also plans to employ petaflop supercomputing to obtain new insights into the specific properties of the different hardware architectures. A set of demonstration experiments will link multiscale analysis of biological systems with functionally and architecturally equivalent synthetic systems and offer the possibility for quantitative statements on the validity of theories bridging multiple scales. The demonstration experiments will also explore non-von Neumann computing outside the realm of brain-science. BrainScaleS will establish close links with the EU Brain-i-Nets and the Blue Brain project at the EPFL Lausanne. The consortium consists of a core group of 10 partners with 13 individual groups. Together with other projects and groups the BrainScaleS consortium plans to make important contributions to the preparation of a future FET flagship project. This project will address the understanding and exploitation of information processing in the human brain as one of the major intellectual challenges of humanity with vast potential applications.

This project started on January 1st, 2011 and is funded for four years.

6.1.1.2. FACETS-ITN
6.1.1.3. SEARISE

Title: SEARISE
Defi: Smart Eyes, Attending and Recognizing Instances of Salient Events
Duration: March 2008 - February 2011
Coordinator: Fraunhofer Institute for Applied Information Technology FIT (Germany)
Other partners:
   Institution: Ulm University (Germany)
   Laboratory: Department of Neural Information Processing
   Researcher: Heiko Neumann

See also: http://www.searise.eu/web/doku.php

Abstract: The SEARISE project developed a trinocular active cognitive vision system, the Smart-Eyes, for detection, tracking and categorization of salient events and behaviours. Inspired by the human visual system, a cyclopean camera performs wide range monitoring of the visual field while active binocular stereo cameras will fixate and track salient objects, mimicking a focus of attention that switches between different interesting locations. The core of this artificial cognitive visual system is a dynamic hierarchical neural architecture – a computational model of visual processing in the brain. Information processing in Smart-Eyes is highly efficient due to a multi-scale design: Controlled by the cortically plausible neural model, the active cameras provide a multi-scale video record of salient events. The processing self-organizes to adapt to scale variations and to assign the majority of computational resources to the informative parts of the scene. The Smart-Eyes system has been tested in real-life scenarios featuring the activity of people in different scales. In a long-range distance scenario, the system analysed crowd behaviour of sport fans in a football arena. In a short range scenario, the system analysed the behaviour of small groups of people and single individuals.

6.1.2. Collaborations in European Programs, except FP7

6.1.2.1. ERC NerVi

Program: ERC IDEAS
Project acronym: NerVi
Project title: From single neurons to visual perception
Duration: January 2009 - December 2013
Coordinator: Olivier Faugeras
Abstract: The project is to develop a formal model of information representation and processing in the part of the neocortex that is mostly concerned with visual information. This model will open new horizons in a well-principled way in the fields of artificial and biological vision as well as in computational neuroscience. Specifically the goal is to develop a universally accepted formal framework for describing complex, distributed and hierarchical processes capable of processing seamlessly a continuous flow of images. This framework features notably computational units operating at several spatiotemporal scales on stochastic data arising from natural images. Mean-field theory and stochastic calculus are used to harness the fundamental stochastic nature of the data, functional analysis and bifurcation theory to map the complexity of the behaviours of these assemblies of units. In the absence of such foundations, the development of an understanding of visual information processing in man and machines could be greatly hindered. Although the proposal addresses fundamental problems, its goal is to serve as the basis for ground-breaking future computational development for managing visual data and as a theoretical framework for a scientific understanding of biological vision.

6.2. International Initiatives

6.2.1. INRIA Associate Teams

6.2.1.1. CORTINA

Title: Retina neural network coding
principal investigator: Frédéric Alexandre (INRIA Cortex)

International Partner (for NeuroMathComp):
  Institution: University of Valparaiso (Chile)
  Laboratory: Centro Interdisciplinario de Neurociencia de Valparaiso
  Researcher: Adrian PALACIOS

International Partner:
  Institution: UTFSM Valparaiso (Chile)
  Laboratory:Direccion General de Investigacion y Postgrado
  Researcher: Maria-Jose ESCOBAR

Duration: 2011 - 2013
See also: http://cortex.loria.fr/Projects/Cortina

Much progress has been made in the last decades in understanding the basic organization and function of the nervous system in general. Contributions to this end have come from various domains including computational neuroscience and numerical science of the information in general. The goal of this associate team is to combine our complementary expertise, from experimental biology and mathematical models (U de Valparaiso and U Federico Santa-Maria) to computational neuroscience (CORTEX and NEUROMATHCOMP), in order to develop numerical tools for the study and characterization of neural coding and related sensory-motor loops. Recording and modeling spike trains from the retina neural network, an accessible part of the brain, is a difficult task that our partnership can address, what constitute an excellent and unique opportunity to work together sharing our experience and to focus in developing computational tools for methodological innovations. To understand how the neural spike coding from natural image sequences works we are addressing the following issues: How visual signals are coded at earlier steps in the case of natural vision? What are their functions? What are the computational “coding” principles explaining (in artificial or biological system) the statistical properties of natural images? We wish to advance our actual knowledge in natural
and artificial visual signals processing and apply it to the field of education; to foster better capacities for learning and memory; sensory prosthesis design, to will help unpaired sensory persons to sense the world and physical rehabilitation, among others. In the context of the cooperation between the INRIA and Chile we propose to develop new neural decoding algorithms that are transverse to several field and applications.

6.2.2. Participation In International Programs

6.2.2.1. KEOPS

Title: Algorithms for modeling the visual system: From natural vision to numerical applications.

principal investigator: Thierry Viéville (Cortex)

International Partner for NeuroMathComp:

Institution: University of Valparaiso (Chile)
Laboratory: Centro Interdisciplinario de Neurociencia de Valparaiso
Researcher: Adrian PALACIOS

International Partner:

Institution: UTFSM Valparaiso (Chile)
Laboratory: Direccion General de Investigacion y Postgrado
Researcher: Maria-Jose ESCOBAR

Duration: 2011 - 2013

See also: http://cortex.loria.fr/Research/Keops

KEOpS attempts to study and model the non-standard behavior of retinal (ganglion cells) sensors observed in natural scenarios. KEOpS also attempts to incorporate the resulting models into real engineering applications as new dynamical early-visual modules. The retina, an accessible part of the brain, is a unique model for studying the neural coding principles for natural scenarios. A recent study proposes that some visual functions (e.g. movement, orientation, anticipatory temporal prediction, contrast), thought to be the exclusive duty of higher brain centers, are actually carried at the retina level. The anatomical and physiological segregation of visual scenes into spatial, temporal and chromatic channels begins at the retina through the action of local neural networks. However, how the precise articulation of this neural network contributes to local solutions and global perception necessary to resolve natural task remains in general a mystery. KEOpS thus attempts to study the complexity of retinal ganglion cells (the output to the brain) behaviors observed in natural scenarios2 and to apply this result to artificial visual systems. We revisit both the retinal neural coding information sent to the brain, and at the same time, the development of new engineering applications inspired by the understanding of such neural encoding mechanisms. We develop an innovative formalism that takes the real (natural) complexity of retinal responses into account. We also develop new dynamical early-visual modules necessary to solve visual problems task.
NUMED Project-Team (section vide)
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Digiteo: Hidinim Project

Participants: Bertrand Thirion [Correspondant], Virgile Fritsch.

High-dimensional Neuroimaging—Statistical Models of Brain Variability observed in Neuroimaging

This is a joint project with Select project team and with SUPELEC Sciences des Systèmes (E3S), Département Signaux & Systèmes Électroniques (A. Tennenhaus).

Statistical inference in a group of subjects is fundamental to draw valid neuroscientific conclusions that generalize to the whole population, based on a finite number of experimental observations. Crucially, this generalization holds under the hypothesis that the population-level distribution of effects is estimated accurately. However, there is growing evidence that standard models, based on Gaussian distributions, do not fit well empirical data in neuroimaging studies.

In particular, Hidinim is motivated by the analysis of new databases hosted and analyzed at Neurospin that contain neuroimaging data from hundreds of subjects, in addition to genetic and behavioral data. We propose to investigate the statistical structure of large populations observed in neuroimaging. In particular, we will investigate the use of region-level averages of brain activity, that we plan to co-analyse with genetic and behavioral information, in order to understand the sources of the observed variability. This entails a series of modeling problems that we will address in this project: i) Distribution normality assessment and variables covariance estimation, ii) model selection for mixture models and iii) setting of classification models for heterogeneous data, in particular for mixed continuous/discrete distributions.

8.1.2. Digiteo: MMoVNI project

Participants: Bertrand Thirion [Correspondant], Pierre Fillard, Viviana Siless, Stéphanie Allassonnière, Hao Xu.

This is a joint project with CMAP http://www.cmapx.polytechnique.fr/~allassonniere/, for the 2010-2013 period.

Modelling and understanding brain structure is a great challenge, given the anatomical and functional complexity of the brain organ. In addition to this, there is a large variability of these characteristics among the population. To give a possible answer to these issues, medical imaging researchers proposed to construct a template image. Most of the time, these analysis only focus on one category of signals (called modality), in particular, the anatomical one was the main focus of research these past years. Moreover, these techniques are often dedicated to a particular problem and raise the question of their mathematical foundations. The MMoVNI project aims at building atlases based on multi-modal images (anatomy, diffusion and functional) data bases for given populations. An atlas is not only a template image but also a set of admissible deformations which characterize the observed population of images. The estimation of these atlases will be based on a new generation of deformation and template estimation procedures that builds an explicit statistical generative model of the observed data. Moreover, they enable to infer all the relevant variables (parameters of the atlases) thanks to stochastic algorithms. Lastly, this modeling allows also to prove the convergence of both the estimator and the algorithms which provides a theoretical guarantee to the results. The models will first be proposed independently for each modality and then merged together to take into account, in a correlated way, the anatomy, the local connectivity through the cortical fibers and the functional response to a given cognitive task. This model will then be generalized to enable the non-supervised clustering of a population. This leads therefore to a finer representation of the population and a better comparison for classification purposes for example. The Neurospin center, partner of this project, will allow us to have access to databases of images of...
high-quality and high-resolution for the three modalities: anatomical, diffusion and functional imaging. This project is expected to contribute to making neuroimaging a more reliable tool for understanding inter-subject differences, which will eventually benefit to the understanding and diagnosis of various brain diseases like Alzheimer’s disease, autism or schizophrenia.

8.2. National Initiatives

8.2.1. ANR IRMGroup

Participants: Bertrand Thirion [Correspondant], Alexandre Gramfort, Michael Eickenberg.

This is a joint project with Polytechnique/CMAP http://www.cmap.polytechnique.fr/: Stéphanie Allassonnière and Stéphane Mallat (2010-2013).

Much of the visual cortex is organized into visual field maps, which means that nearby neurons have receptive fields at nearby locations in the image. The introduction of functional magnetic resonance imaging (fMRI) has made it possible to identify visual field maps in human cortex, the most important one being the medial occipital cortex (V1,V2,V3). It is also possible to relate directly the activity of simple cells to an fMRI activation pattern and Parietal developed some of the most effective methods. However, the simple cell model is not sufficient to account for high-level information on visual scenes, which requires the introduction of specific semantic features. While the brain regions related to semantic information processing are now well understood, little is known on the flow of visual information processing between the primary visual cortex and the specialized regions in the infero-temporal cortex. A central issue is to better understand the behavior of intermediate cortex layers.

Our proposition is to use our mathematical approach to formulate explicitly some generative model of information processing, such as those that characterize complex cells in the visual cortex, and then to identify the brain substrate of the corresponding processing units from fMRI data. While fMRI resolution is still too coarse for a very detailed mapping of detailed cortical functional organization, we conjecture that some of the functional mechanisms that characterize biological vision processes can be captured through fMRI; in parallel we will push the fMRI resolution to increase our chance to obtain a detailed mapping of visual cortical regions.

8.2.2. ANR Vimagine

Participants: Bertrand Thirion [Correspondant], Alexandre Gramfort, Michael Eickenberg, Fabian Pedregosa.

Vimagine is an ANR blanc project (2008-2012), which aims at building a novel view on the retinotopic organization of the visual cortex, based on fMRI and MRI. Vimagine should open the way to understanding the dynamics of brain processes for low-level vision, with an emphasis on neuropathologies. This project is leaded by S. Baillet (MMiXT, CNRS UPR640 LENA, Pitié-Salpêtrière), in collaboration with M.Clerc, T. Papadopoulos (INRIA Sophia-Antipolis, Odyssée) and J. Lorenceau(LPPA, CNRS, Collège de France). The fMRI part of the project will be done by PARIETAL, and will consist in a study of spatially resolved retinotopic maps at the mm scale, the decoding of retinotopic information and the comparison of retinotopy with sulco-gyral anatomy.

8.2.3. ANR BrainPedia

Participants: Bertrand Thirion [Correspondant], Yannick Schwartz, Virgile Fritsch.

BrainPedia is an ANR JCJC (2011-2015) which addresses the following point:

Neuroimaging produces huge amounts of complex data that are used to better understand the relations between brain structure and function. While the acquisition and analysis of this data is getting standardized in some aspects, the neuroimaging community is still largely missing appropriate tools to store and organise the knowledge related to the data. Taking advantage of common coordinate systems to represent the results of group studies, coordinate-based meta-analysis approaches associated with repositories of neuroimaging publications provide a crude solution to this problem, that does not yield reliable outputs and looses most of the data-related information. In this project, we propose to tackle the problem in a statistically rigorous framework, thus providing usable information to drive neuroscientific knowledge and questions.
8.3. International Initiatives

8.3.1. INRIA Associate Teams

8.3.1.1. CAPNEONATES

Title: Analysis of structural MR and DTI in neonates
INRIA principal investigator: Pierre Fillard
International Partner:
  Institution: University of Southern California (United States)
  Laboratory: Image Lab at Children Hospital at Los Angeles
  Researcher: Natasha Lepore
International Partner:
  Institution: University of Pennsylvania (United States)
  Laboratory: Penn Image Computing and Science Laboratory
  Researcher: Caroline Brun

Duration: 2011 - 2013
See also: http://www.capneonates.org/

While survival is possible at increasingly lower gestational ages at birth, premature babies are at higher risk of developing mental disorders or learning disabilities than babies born at term. A precise identification of the developmental differences between premature and control neonates is consequently of utmost importance. Nowadays, the continuously improving quality and availability of MR systems makes it possible to precisely determine, characterize and compare brain structures such as cortical regions, or white matter fiber bundles. The objective of this project is to understand the developmental differences of premature versus normal neonates, using structural and diffusion MRI. This work will consist in identifying, characterizing and meticulously studying the brain structures that are different between the two groups. To do so, we propose to join forces between the Parietal team at INRIA and the University of Southern California. Parietal has a recognized expertise in medical image registration and in statistical analyses of groups of individuals. USC has a broad knowledge in MR image processing. In particular, the Children’s Hospital at Los Angeles (CHLA), which is part of USC, is in the process of collecting a unique database of several hundreds of premature and normal neonates MR scans. This joint collaboration is consequently a unique chance of addressing key questions pertaining to neonatal and premature development. It will make it possible to elaborate new tools to analyze neonate MR images while tremendously increasing our knowledge of neuroanatomy at such an early stage in life.

8.3.2. INRIA International Partners

- LIAMA http://www.nlpr.ia.ac.cn/jiangtz/ : B.Thirion visited LIAMA (contact person: Shan Yu) in May and gave a presentation. We plan to develop some collaborations on fMRI data analysis and functional connectivity in the future.
- Donders institute https://sites.google.com/a/distrep.org/distrep/marcel-van-gerven : We share with M. van Gerven some interest on biological vision and on the use of fMRI to probe specific hypotheses related to computational models of vision. We hope to have a student in common in the future.
- Biomedical Image analysis group, Imperial College, London http://www.doc.ic.ac.uk/~dr/ : We have started some joint work on the comparison of functional and anatomical connectivity using machine learning tools. We showed preliminary common contributions at IPMI and MLINI 2011.
Computational Sciences for Biology, Medicine and the Environment - Other Grants and Activities - Project-Team PARIETAL

- MIT, CSAIL http://www.csail.mit.edu/ , P.Golland’s group: we regularly visit each other and share common interests in the use of machine learning for neuroimaging, in the introduction of functional information into co-registration procedures, and in the study and comparison of anatomical and functional connectivity. We plan a common project and more visits for next year.

8.3.3. Visits of International Scientists

Bernard Ng, from Biomedical Image and Signal Computing Laboratory, British Columbia University http://bisicl.ece.ubc.ca/ , has visited Parietal from Sept 1st, 2010 to March 1st, 2011. The collaboration is about the introduction of functional connectivity into the analysis of fMRI activation data.

8.3.4. Participation In International Programs

Parietal has taken part to the program INRIA@SiliconValley, and had a 18-months post-doc funded to work on the comparison of anatomical and functional connectivity (18 months, 2011-2013):

In this project, we would like to build probabilistic models that relates quantitatively the observations in anatomical and functional connectivity. For instance given a set of brain regions, the level of functional integration might be predicted by the anatomical connectivity measurement derived from the fibers in a given population of subjects. More generally, we will seek to extract latent factors explaining both connectivity measures across the population. Such models require specifically that a generative model is proposed to explain the observations in either domain, so that a meaningful and testable link is built between the two modalities. The inference problem can then be formulated as learning the coupling parameters that are necessary to model the association between modalities, and tested e.g. by assessing the ability of the learned model to generalize to new subjects. The aim is then to provide the mathematical and algorithmic tools necessary to build a standardized model of brain connectivity informed by both modalities, associated with confidence intervals to take into account between subject variability. Such an atlas is a long-term project, that requires adequate validation on high-resolution data, but it will probably be tightly linked to this project.
7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR Project “M3RS”

Participants: Laurent Boudin, Muriel Boulakia, Paul Cazeaux, Anne-Claire Egloffe, Céline Grandmont [Principal Investigator], Bérénice Grec, Sébastien Martin.

This project, coordinated by C. Grandmont, aims at studying mathematical and numerical issues raised by the modeling of the lungs.

7.1.2. ANR Project “Endocom”

Participants: Miguel Ángel Fernández Varela, Jean-Frédéric Gerbeau [correspondant], Joaquín-Alejandro Mura Mardones.

This project is funded by the TECSAN call (health technology) of the ANR. It aims at developing a pressure sensor embedded on an endoprosthesis.

7.1.3. INRIA Research Collaborative Action “Sirap”

Participants: Miguel Ángel Fernández Varela, Jean-Frédéric Gerbeau [Principal Investigator], Romain Guibert, Irène Vignon-Clementel.

This project is in collaboration with Dr. Younes Boudjemline (Necker Hospital Paris) and project-team Asclepios. Its aim is to model and design an endovascular reducer for pulmonary artery outflow tract.

7.2. European Initiatives

7.2.1. FP7 Projet

7.2.1.1. EUHEART

Participants: Cristóbal Bertoglio Beltran, Miguel Ángel Fernández Varela, Jean-Frédéric Gerbeau [correspondant], Saverio Smaldone.

Period: 2008-2012
REO is a member of the Integrated Project “euHeart” whose goal is the development of individualized, computer-based, human heart models. The project euHeart consists of seventeen industrial, clinical and academic partners. REO is specifically involved in the modeling and simulation of cardiac valves and aorta (including inverse problems).

7.3. International Initiatives

7.3.1. Trans-Atlantic Network of Excellence for Cardiovascular Research

Participants: Grégory Arbia, Jean-Frédéric Gerbeau, Irène Vignon-Clementel [correspondant].

Period: 2010-2014

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This network, funded by the Leducq foundation, is working on the multi-scale modeling of single ventricle hearts for clinical decision support5.

7.3.2. INRIA Associate Teams

Participants: Grégory Arbia, Cristóbal Bertoglio Beltran, Miguel Ángel Fernández Varela, Jean-Frédéric Gerbeau, Céline Grandmont, Irène Vignon-Clementel [coordinator].

Period: 2008-2014

CARDIO: The aim of this project is to foster the collaboration between the Cardiovascular Biomechanics Research Laboratory (CVBRL) of C.A. Taylor (Stanford University, USA) and colleagues such as Dr. Feinstein, and the project-team REO, through research on cardiovascular and respiratory related topics (boundary conditions for complex flow, patient-specific modeling of congenital heart disease, image-based fluid solid interaction, postprocessing of numerical simulations). The associated team has been extended to other partners: team-project MACS at INRIA, the Marsden group at USCD and the Flow physics group at IIT. CA Figueroa is now at KCL, UK.

7.3.3. Visiting professors

- Francesco Salvarani, Professor, Univ. degli studi di Pavia (Italy), January 15 - July 13, 2011
- André Garon, Professor, Département Génie Mécanique de l’Ecole Polytechnique de Montréal (Canada) 10-17 may, 2011
- Erik Burman, Professor, University of Sussex, UK, December 12-16, 2011

7.3.4. Internships

- Jessica Oakes, PhD candidate, University of California, San Diego, July 1st - September 30, 2011.

5 http://modelingventricle.clemson.edu/home
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Sofa, ADT
SOFA Large Scale Development Initiative (ADT) : the SOFA project (Simulation Open Framework Architecture) is an international, multi-institution, collaborative initiative, aimed at developing a flexible and open source framework for interactive simulations. This will eventually establish new grounds for a widely usable standard system for long-term research and product prototyping, ultimately shared by academic and industrial sites. The SOFA project involves 3 INRIA teams, SHAMAN, EVASION and ASCLEPIOS. The development program of the ADT started in 2007. After 3 years of development, more than 600,000 lines of code have been developed, 80,000 downloads of SOFA have been counted on the INRIA gForge, and we are about to finalize a new version of the public release.

8.1.2. Sofa Intermeds, AEN
SOFA Large Scale Initiative on Medical Simulation (AEN): The variety and complexity of Medicine, as well as its ethical importance in today’s society, have been a strong motivation in many scientific and technical disciplines. The medical field has already been a domain of application for computer science and several tools, such as image processing, are now an integral part of modern medicine. Yet, there is no question that the integration of new technologies in Medicine will continue to rise in the future. In this context, the simulation of medical procedures, whether it is targeted at education, planning of interventions, or even guidance during complex procedures, will be a major element of the Medicine of the twenty-first century. The main objective of this large scale initiative is to leverage expertise from a few research teams at INRIA to speed up the development of new ideas, models, algorithms in this very multi-disciplinary field. This initiative started in 2008, and involves several teams at INRIA: SHAMAN, EVASION, ASCLEPIOS, MOAIS, MAGRIT, and BUNRAKU. This program has been evaluated by a group of international experts in October 2010.

8.1.3. ANR Acoustic
The main objective of this project is to develop an innovative strategy based on models for helping decision-making process during surgical planning in Deep Brain Stimulation. Models will rely on different levels involved in the decision-making process; namely multimodal images, information, and knowledge. Two types of models will be made available to the surgeon: patient specific models and generic models. The project will develop methods for 1) building these models and 2) automatically computing optimal electrodes trajectories from these models taking into account possible simulated deformations occurring during surgery.

The project belongs to the multidisciplinary domain of computer-assisted surgery (CAS). Computer assisted surgery aims at helping the surgeon with methods, tools, data, and information all along the surgical workflow. More specifically, the project addresses surgical planning and surgical simulation in Image Guided Surgery. It is related to the exponentially growing surgical treatment of Deep Brain Stimulation (DBS), originally developed in France by Pr. Benabid (Grenoble Hospital). The key challenges for this research project are 1) to identify, extract, gather, and make available the information and knowledge required by the surgeon for targeting deep brain structures for stimulation and 2) to realistically simulate the possible trajectories.

8.1.4. IHU, Strasbourg
Our team has been selected to be part of the IHU of Strasbourg. This new institute, for which funding (67M?) has just been announced, is a very strong innovative project of research dedicated to future surgery of the abdomen. It will be dedicated to minimally invasive therapies, guided by image and simulation. Based on interdisciplinary expertise of academic partners and strong industry partnerships, the IHU aims at involving several specialized groups for doing research and developments towards hybrid surgery (gesture of the surgeon and simulation-based guidance). Our group and SOFA have a important place in the project. For this reason, Stephanie Cotin has moved to Strasbourg for one year (Sept 2011 to July 2012).
8.2. European Initiatives

8.2.1. Collaborations in European Programs

Program: FP7
Project acronym: PASSPORT
Project title: PAtient Specific Simulation and PreOperative Realistic Training for liver surgery
Duration: May 2008 - November 2011
Coordinator: IRCAD

Other partners: ETH, Computer Vision Laboratory (Switzerland), Technische Universität München, Computer-Aided Medical Procedures (Germany), Imperial College London (UK), Inserm (France), Storz (Germany), Université de Strasbourg (France), Universität Leipzig, Interdisciplinary Centre for Bioinformatics (Germany),

Abstract: PASSPORT (PAtient Specific Simulation and PreOperative Realistic Training for liver surgery), is a 3-year project that deals directly with the objectives of the "Virtual Physiological Human" ICT-2007.5.3 objective. Indeed, PASSPORT's aim is to develop patient-specific models of the liver which integrates anatomical, functional, mechanical, appearance, and biological modeling. To these static models, PASSPORT will add dynamics liver deformation modeling and deformation due to breathing, and regeneration modeling providing a patient specific minimal safety standardized FLR. These models, integrated in the Open Source framework SOFA, will culminate in generating the first multi-level and dynamic "Virtual patient-specific liver" allowing not only to accurately predict feasibility, results and the success rate of a surgical intervention, but also to improve surgeons' training via a fully realistic simulator, thus directly impacting upon definitive patient recovery suffering from liver diseases.
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. **GNR MOMAS: project on reactive transport**

**Participants:** Jocelyne Erhel, Souhila Sabit.


The working group MOMAS includes many partners from CNRS, INRIA, universities, CEA, ANDRA, EDF and BRGM. It covers many subjects related to mathematical modeling and numerical simulations for nuclear waste disposal problems. We coordinate the project entitled “numerical models and simulations for transport by advection diffusion of chemical species with kinetic and equilibrium reactions.”

See sections 6.4.3, 4.2, 7.1.

8.1.2. **ANR-CIS: MICAS project**

**Participants:** Julia Charrier, Jocelyne Erhel, Aurélien Le Gentil, Géraldine Pichot, Baptiste Poirriez, Nadir Soualem.

Contract with ANR, program CIS

Time: four years from January 2008.

Title: Modelling and Intensive Computation for Aquifer Simulations.

Coordinator: Sage.

Partners: Geosciences Rennes, University of Le Havre, University of Lyon 1.

Web page: [http://www.irisa.fr/sage/micas](http://www.irisa.fr/sage/micas)

See sections 6.4, 6.5, 6.6, 5.1, 4.2.

8.1.3. **ANR-RNTL: LIBRAERO project**

**Participants:** Denis Billon, Jocelyne Erhel, Désiré Nuentsa Wakam.

Contract with ANR, program RNTL

Time: three years from October 2007.

Title: Large Information Base for the Research in AEROdynamics.

Coordinator: FLUOREM, Lyon.

Partners: LMFA, Ecole Centrale de Lyon; CDCSP, University of Lyon; Sage team.

This work is done in the context of the CINEMAS2 project, section 7.2.

See section 6.1, 5.7.

8.1.4. **GENCI: project on advanced linear solvers**

**Participants:** Édouard Canot, Désiré Nuentsa Wakam, Jocelyne Erhel, Aurélien Le Gentil, Baptiste Poirriez, Nadir Soualem, Géraldine Pichot.


To run large simulations, we defined a project, based on H2OLab and GPREMS, accepted by Genci. We got accounts on the cluster IBM Power 6 located at IDRIS. In 2011, we obtained and used hours.

See sections 5.1 and 5.7.

8.1.5. **INRIA Large Wingspan initiative: HEMERA project**

**Participants:** Jocelyne Erhel, Nadir Soualem, Géraldine Pichot.
Title: Hemera
Time: from September 2010.
Coordinator: C. Perez, GRAAL team.
Partners: 22 INRIA teams.

Hemera is an INRIA Large Wingspan project, started in 2010, that aims at demonstrating ambitious up-scaling techniques for large scale distributed computing by carrying out several dimensioning experiments on the Grid’5000 infrastructure, at animating the scientific community around Grid’5000 and at enlarging the Grid’5000 community by helping newcomers to make use of Grid’5000.

The team Sage is the leader of the Scientific Challenge Hydro: Multi-parametric intensive stochastic simulations for hydrogeology. The objective is to run multiparametric large scale simulations. Experiments have been conducted on Grid’5000 in 2011, in collaboration with D. Balouek, engineer in team GRAAL, Lyon. They show that our approach based on a two-level parallelism for Monte-Carlo simulations is quite efficient.

See sections 6.4, 6.5, 6.6, 8.1.2, 5.1.

8.2. European Initiatives

8.2.1. Marie Curie program: Co-Advise project

Participants: Jocelyne Erhel, Sinda Khalfallah, Mestapha Oumouni, Bernard Philippe.

Type of project: COADVISE Project supported by the European Commission [Seventh Framework Programme - Marie Curie Actions ‘People’ International Research Staff Exchange Scheme (IRSES)].
Time: It started in February 2009 for a duration of 36 months.

The project aims at supporting and strengthening the different existing collaboration actions between Europe and Mediterranean Partner Countries. The structuring action of the programme consists in co-advising PhD students between the two sides of the Mediterranean Sea. The project is coordinated by INRIA Centre de Recherche Sophia Antipolis. There are 5 partners in Tunisia, 2 partners in Morocco, 1 partner in Algeria, 1 partner in Italy, 1 partner in Spain and 1 partner in France.

In 2011, two PhD students visited the Sage team during 6 months each: Sinda Khalfallah, Tunisia; Mestapha Oumouni, Morocco.

See sections 8.3.4, 6.6.

8.2.2. European collaborations

UPC: Universitat Politècnica de Catalunya-UPC, Institute of Environmental Assessment and Water Research (Spain)
numerical simulations in hydrogeology, reactive transport in heterogeneous media, upscaling, scientific software platform.

UFZ: Helmholtz Centre for Environmental Research-UFZ, Hydrogeology group (Germany)
numerical simulations in hydrogeology, flow in porous fractured media, scientific software platform.

University of Patras, High Performance Information Systems Laboratory (Greece)
cooperation with B. Philippe in editing a book, in writing a book, and in common research on low rank approximations of matrix functions.

ERCIM working group
numerical algorithms, high performance computing.
8.3. International Initiatives

8.3.1. Visits of International Scientists

- E. Gallopoulous, professor University of Patras, Greece, 2 months, January-March
- E. Kamgnia, professor University of Yaounde 1, Cameroon, 2 months, March
- D. Sorensen, professor University of Rice, USA, 1 week, May
- M. Muhieddine, associate professor University of , Lebanon, 2 weeks, June
- F.-Z. Nouri, professor University Badji Mokhtar, Algeria, 2 weeks, December

8.3.2. Internship

- F. Saceh, PhD student, University Badji Mokhtar, Algeria, 3 months, April-July
- M. ben Refifa, Master student, ENIT, Tunisia, 3 months, May-July
- L.-B. Nguenang, PhD student, University of Yaounde 1, Cameroon, 4 months, November 2011-February 2012

8.3.3. Visits to international laboratories

- É. Canot, University Badji Mokhtar, Algeria, 1 week, April
- B. Philippe, University Badji Mokhtar, Algeria, 1 week, October
- É. Canot, University of Yaounde 1, Cameroon, 1 week, November

8.3.4. INRIA Euro-Mediterranean Program: HYDROMED project

Participants: Édouard Canot, Jocelyne Erhel, Sinda Khalfallah, Mestapha Oumouni.

Title: Inverse problems in hydrogeology
Time: 2009 - 2011
 Coordination: LAMSIN, Tunis, Tunisia.
 Partners: Rabat (Morocco), Kenitra (Morocco), Annaba (Algeria), Tunis (Tunisia), Naples (Italy), Barcelona (Spain), Paris and Rennes.
 Webpage: http://www.lamsin.rnu.tn/ 

The project deals with the numerical simulation of groundwater flow and the transport of pollutants. A workshop was organized in Tunis, in December 2011. See sections 8.3.1, 8.2.1, 6.6.

8.3.5. LIRIMA network: MOMAPLI team

Participant: Bernard Philippe.

Title: Modélisation Mathématique et Applications
Time: 2010-2013
Partner: University of Yaounde, Cameroon.

The project deals with high performance scientific computing. See sections 8.3.1, 8.3.3, 6.2.3.

8.3.6. LIRIMA network: EPIC team

Participants: Amine Abdelmoula, Bernard Philippe, Jocelyne Erhel, Sinda Khalfallah.

Time: 2011-2013
Partner: ENIT, University of Tunis, Tunisia.

The project deals with nonlinear problems and inverse problems. See sections 8.3.1, 6.6.

8.3.7. LIRIMA network: CSPE team

Participants: Édouard Canot, Bernard Philippe.
Title: Calcul Scientifique pour des Problèmes en Environnement
Time: 2010-2011
Partner: University of Annaba, Algeria.

The project deals with the numerical simulation of fluid flows. See sections 8.3.1, 8.3.3.

8.3.8. INRIA and UIUC: Joint Laboratory for Petascale Computing
Participants: Désiré Nuentsa Wakam, Jocelyne Erhel.

Webpage: http://jointlab.ncsa.illinois.edu/

The team Sage participated in the workshop organized in June at Grenoble (France).

The team works on deflation methods and their integration into the software PETSc. See sections 6.1, 5.7.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Computing and storage facilities

Participant: Charles Kervrann.

The aim is to design a computing architecture to process bioimaging data sets and to deal with the data flow from the different imaging microscopy platforms. The software packages will manage the needs of end users in Rennes, where interactivity with the imaging devices and information systems might be desirable.

Funding: Rennes-Metropole - “Allocation Installation Scientifique”

8.1.2. Cryo-Soft project

Participant: Charles Kervrann.

The goal of this project is to develop image processing softwares (TubuleJ (5.5), Cryo-Seg (5.6), ...) and to design user-friendly interfaces for applications in cryo-electron microscopy.

Funding: University of Rennes 1 - “Emerging Scientific Challenges” program

Partner: UMR 6026 CNRS University of Rennes 1

8.2. National Initiatives

8.2.1. Quaero project

Participant: Charles Kervrann.

Quaero is a European collaborative research and development program with the goal of developing multimedia and multi-lingual indexing and management tools for professional and public applications. SERPICO team participates in the Work Package 9 on Video Processing (WP9) of QUAERO Core Technology Cluster Project (CTC). Within WP9, former Vista project-team leaded three tasks: “Motion Recognition”, “Object Tracking” and “Event Recognition”. Since October 2010, SERPICO have conducted activities in object tracking and indexing for video-microscopy analysis (Denis Fortun’s PhD grant (6.1)).

Funding: Quaero (no. Inria Alloc 3184), duration: 30 months

Partner: 24 academic and industrial partners leaded by Technicolor

8.2.2. LI-FLIM project

Participants: Charles Kervrann, Philippe Roudot.

The goal is to develop lifetime estimation methods of moving vesicles in FLIM microscopy. Grant to support collaboration between SERPICO team and UMR 144 CNRS PICT-IBiSA Institut Curie (P. Roudot’s PhD (6.2))

Funding: GdR 2588 “Microscopie Fonctionnelle du Vivant” - Mobility grant

Partner: UMR 144 CNRS PICT IBiSA Institut Curie

8.2.3. DADA project

Participant: Charles Kervrann.
The accurate control of the growing and guidance of neuronal extensions to their target is a very important step for the maturation of the nervous system. The goal of this project (http://www-sop.inria.fr/members/Xavier.Descombes/DADA/home.html) is to develop new computational techniques to analyze image sequence of 3D volumes containing a population of growing axons.

**Funding:** Inria ARC (2011-2012)

**Partners:** Inria Morpheme team and IBDC, laboratory from University of Nice Sophia Antipolis

### 8.2.4. Bio-IP toolbox

**Participants:** Charles Kervrann, Tristan Lecorgne, Pierre Hellier.

The goal of this project is to integrate software tools (Section 5) in user-friendly interfaces. The softwares have been developed in various bioimaging projects and some of them required GPU accelerations for facing high-content microscopy. The softwares and plug-in will be used by biologists to explore image data.

**Funding:** Inria ADT (2011-2013)

**Partner:** UMR 144 CNRS PICT IBiSA Institut Curie

### 8.2.5. France-BioImaging project

**Participants:** Charles Kervrann, Tristan Lecorgne.

The goal of the project is to build a distributed coordinated French infrastructure for photonic and electronic cellular bioimaging dedicated to innovation, training and technology transfer. High computing capacities are needed to exhaustively analyse image flows. We address the following problems: i/ exhaustive analysis of bioimaging data sets; ii/ deciphering of key steps of biological mechanisms at organ, tissular, cellular and molecular levels through the systematic use of time-lapse 3D microscopy and image processing methods; iii/ storage and indexing of extracted and associated data and metadata through an intelligent data management system.

**Funding:** Investissement d’Avenir - Infrastructures Nationales en Biologie et Santé (2011-2016)

**Partners:** CNRS, Institut Jacques Monod, Institut Pasteur, Institut Curie, ENS Ulm, Ecole Polytechnique, INRA, INSERM

### 8.3. European Initiatives

#### 8.3.1. ESFRI Euro-BioImaging initiative

**Participant:** Charles Kervrann.

SERPICO participates to the ESFRI Euro-BioImaging project, one of the four new biomedical sciences projects in the roadmap of the European Strategic Forum on Research Infrastructures (ESFRI). The mission of Euro-BioImaging is to provide access, service and training to state-of-the-art imaging technologies and foster the cooperation and networking at the national and European level including multidisciplinary scientists, industry regional, national and European authorities. (3-year Preparatory Phase / start: December 2010). SERPICO also participates to the French counterpart, the so-called “France-BioImaging” (FBI) network which gathers several outstanding cellular imaging centers (microscopy, spectroscopy, probe engineering and signal processing) as described in Section 8.2.5.

### 8.4. International Initiatives

#### 8.4.1. Inria International Partners

Collaboration with University of California - San Francisco (USA), J. Sedat and D. Agard, on image denoising in cryo-electron microscopy.

Collaboration with University of Saarland (Germany), Prof. J. Weickert, on optical flow computing (D. Fortun’s visit in 2012 (3 months), Rennes-Metropole grant).

Collaboration with RICAM Linz (Austria), P. Elbau, on non-local image denoising.
7. Partnerships and Cooperations

7.1. Regional Initiatives

Participation to the MODIPRO project funded by Paris Region and Pôle de Compétitivité ASTech.
Partners: Bayesia, Dassault Aviation, INRIA (EPI I4S and Sisyphe), IT4 Control, KBS, Snecma, Supélec, UPMC.
The objective is to improve some algorithms for use in Dassault Aviation aircraft monitoring procedures.

7.2. National Initiatives

REGATE (REgulation of the GonAdoTropE axis) is a 4-year Large Scale Initiative Action funded by INRIA in May 2009 dedicated to the modeling, simulation and control of the gonadotrope axis. The INRIA participants to this action are researchers of 2 INRIA research teams, Contraintes and Sisyphe. There are also participants from INRA, Université Libre de Bruxelles (Unité de Chronobiologie théorique) and Université Paris 6 (Laboratoire Jacques-Louis Lions).

7.3. European Initiatives

7.3.1. Collaborations in European Programs, except FP7

The SISYPHE team is involved in the activities of the European Research Network on System Identification (ERNSI) federating major European research teams on system identification.

Project acronym: ERNSI
Project title: European Research Network System Identification
Duration: 1992 - –
Coordinator: The network ERNSI is currently coordinated by Bo Wahlberg, Automatic Control, KTH SE 100 44 Stockholm, SWEDEN.
Other partners: KTH (Sweden), INRIA (France), TUD (Technische Universität Darmstadt), TUW (Vienna University of Technology), UCAM-DENG (University of Cambridge), ELEC (Vrije Universiteit Brussel), ULIN (Sweden), UNIPD (Italy).
Abstract: Modeling of dynamical systems is fundamental in almost all disciplines of science and engineering, ranging from life science to plant-wide process control. Engineering uses models for the design and analysis of complex technical systems. System identification concerns the construction, estimation and validation of mathematical models of dynamical physical or engineering phenomena from experimental data.

7.4. International Initiatives

7.4.1. INRIA International Partners

Mazyar Mirrahimi has a close collaboration with the QLab group at Yale (Michel Devoret) and the Quantum-Mechanical Electronics Group at ENS Paris (Benjamin Huard). He is on a sabbatical leave at Yale since February 2011.

7.4.2. Visits of International Scientists

Martin Krupa (Nijmegen, Department of Mathematics) has been visiting the project-team for 12 months to set up a collaboration in the field of Mathematical Neuroendocrinology.
STEPP Exploratory Action

7. Partnerships and Cooperations

7.1. Regional Initiatives

Project acronym: MUTERA
Project title: Modèles Urbanisme-Transport-Environnement en Rhône-Alpes
Starting date: 2012
Coordinator: Emmanuel Raoult (AURG)
Other potential partners: IAU-IDF, LET, IDDRI, INRIA, EDDEN, AURG, SMTC, Urba Lyon, Sytral, La Métro, etc.
Abstract: The rich and diverse activity in modeling in Rhône-Alpes region, the need of more technical expertise of the various actors and the necessity for decision makers to be able to project into an uncertain future via innovative tools developed by the research are three elements that push the creation the MUTERA project. MUTERA aims then to gather the main actors in urban planning and transport of Rhône-Alpes region to work on the issues regarding land-use and transport models. This group includes technicians, politicians and researchers. MUTERA kick-off meeting is foresaw in the beginning of 2012.

Project acronym: SOCLE3
Project title: Sustainability, Local Collective Organisation, Energy, Economy and Environment
Coordinator: Pierre-Yves Longaretti (STEEP)
Other partners: LECA (UJF/CNRS), EDDEN (UPMF/CNRS), PACTE (UJF/CNRS), ERIC (Lyon 2/CNRS)
The SOCLE3 interdisciplinary group and project has two major aims:

- Analyzing and modelling the environmental, economic and social interactions at the urban to regional (sub-national) level, and their coupled trajectories under given global and local macroeconomic trends, and climate change constraints.
- Providing decision-makers with policy analysis and evaluation tools, and other researchers with methodological tools, based in particular (but not exclusively) on simulations under relevant global/local scenarios, to identify and characterize possible sustainability transition pathways at the local and regional scales.

7.2. National Initiatives

Program: "Modelling and Scenarios of Biodiversity" flagship program, Fondation pour la Recherche sur la Biodiversité

Project acronym: ESNET (submitted)
Project title: Ecosystem services networks futures for the Grenoble region
Duration: 2012 - 2014
Coordinator: Sandra Lavorel (LECA)
Other partners: LECA (UJF/CNRS), STEEP(INRIA/LJK) , EDDEN (UPMF/CNRS), CEMAGREF Grenoble, PACTE (UJF/CNRS), ERIC (Lyon 2/CNRS)
Abstract: Ecosystem services are underpinned by fundamental ecological properties and processes interacting with society, both through human dependence on these services, and the use and management of ecosystems. Our hypothesis is that ecosystem services can thus be modelled as networks of interacting ecological and societal processes, at multiple spatial and temporal scales. Our interdisciplinary research team proposes to explore this network hypothesis by assessing alternative futures of ecosystem services under combined scenarios of land-use and climate change for the Grenoble urban area in the French Alps. We will capitalize on existing statistical and mechanistic methods to build and integrate models of the relevant ecosystem services and land-use change. Our assessment will benefit from our detailed understanding of how biodiversity and different ecosystem services are interconnected. Trade-offs and synergies will be quantified by a specifically designed spatial multi-criteria analysis. Besides the urban area, we will focus on two case study sub-systems: the intensively farmed valley upstream of the city and a mixed landscape of forests and grasslands in a mountain range south of the city. As beneficiaries of ecosystem services, local and regional stakeholders will be involved in formulating the project working hypotheses and scenarios. These scenarios will build on current urban planning exercises by public authorities and research teams, and downscaling of land-use and climate change projections. We will engage stakeholders in the comparison of scenarios and the assessment of trade-offs in order to foster a dialog on development pathways and mitigation options.

In other respects, we are also strongly connected to the AETIC project. Initially we were not members of this project. But we follow it very closely and we already build on it via our collaboration with EDDEN laboratory and IDDRI. In particular our project of modeling and implementing transport-land use-energy integrated model for the city of Grenoble uses the data and analysis which are generating in the context of AETIC project.

Program: ANR project (Ville durable)
Project acronym: AETIC
Project title: Approche Economique Territoriale Intégrée pour le Climat
Duration: 2010 - 2013
Coordinator: Patrick Criqui (EDDEN)
Partners: UMR EDDEN, company ENERDATA Conseil, VEOLIA Environnement, CSTB (Centre Scientifique et Technique du Bâtiment), IDDRI (Sciences Politiques Paris), UMR PACTE.
Abstract: AETIC project aims to achieve three objectives: 1) to provide economic tools which allow to calculate and integrate costs and quantities useful for the territorial climate policy (PCL—"Plan Climat Local"). 2) to provide an analysis of the PCL of Grenoble metropolitan area. 3) to define a consistent and innovative methodology for the definition of the PCL.

A project related to previous activities in computer vision of project members:

Program: ANR CONTINT
Project acronym: ROM
Project title: Realtime Onset Matchmoving
Duration: 2008 – 2011
Coordinator: Duran Duboi SA
Other partners: VORTEX (IRI Toulouse, France)
Abstract: This industrial R&D project concerns the generation of special effects for movie or other film productions. In particular, the goal is to provide tools for successful onset matchmoving, that is the estimation of camera trajectories during acquisition, with immediate pre-visualization of special effects superimposed on acquired sequences. Besides this real-time aspect of matchmoving, the project also addresses the problem of preparing a shooting, by analyzing if matchmoving with natural features is possible and if not, by instrumenting the scene with artificial markers in appropriate positions.
7.3. European Initiatives

A project related to previous activities in computer vision of project members:

Program: ESA ITI (European Space Agency Triangular Initiatives)
Project acronym: ITI 3D
Project title: Multi-View 3D Reconstruction of Asteroids
Duration: 2010 – 2011
Coordinator: EADS Astrium
Abstract: The goal of the project is to implement and validate algorithms for image-based 3D modeling of asteroids. The algorithms combine multi-view stereo and shape-from-shading.

7.4. International Initiatives

7.4.1. INRIA International Partners

We collaborate closely with Tomàs De La Barra (Modelistica company, Professor at Facultad de Arquitectura y Urbanismo (Venezuela)). Tomàs De La Barra is the founder of the Land-Use and Transport Integrated Model Tranus. In the framework of this collaboration, Tomàs visited us for one week to advance the calibration of Tranus on Grenoble, and an ECOS NORD project has been submitted.

7.4.2. Visits of International Scientists

7.4.2.1. Post-docs

Juho Kannala (2 months, Nov/Dec 2011)
Institution: University of Oulu and National Academy of Finland

7.4.2.2. Internships

Mariano Luis Fernandez (from Apr 2011 until Sep 2011)
Subject: Re-implementation of a land use / transport model
Institution: Universidad Nacional del Centro de la Provincia de Buenos Aires (Argentina)

Luis Manterola (from Jun 2011 until Nov 2011)
Subject: Adaptation of the land use part of TRANUS model to the OPUS framework
Institution: Universidad Nacional del Centro de la Provincia de Buenos Aires (Argentina)

Alejandro Deymonnaz (from Jul 2011 until Dec 2011)
Subject: Shape From Ambient Shading
Institution: Universidad de Buenos Aires (Argentina)

7.4.3. Participation In International Programs

Program: ECOS NORD Venezuela
Project acronym: TRACER (submitted)
Project title: TRanus, Analyse de la Calibration et des Erreurs, Retours sur Grenoble et Caracas
Duration: 2012 - 2015
Coordinator: Laurence Tubiana (IDDRI), Tomàs de le Barra (Facultad de Arquitectura y Urbanismo, Venezuela)
Other partners: IDDRI, STEEP, Facultad de Arquitectura y Urbanismo (Venezuela)

Abstract: Having quantified elements on urban dynamics is necessary if one wants to implement policies that are coherent with sustainable urban objectives. Land use and transport integrated (LUTI) models enable such a quantification. Their use has successfully increased in the framework of urban prospect where environmental issues are preponderant. A large dissemination of such tools in the local authority agencies is nowadays crucial to evaluate urban policies, yet limited by various difficulties, such as lack of robustness and calibration issues. The objective of this project is to bring answers to these limitations. We choose to focus on the Tranus model, one of the most used LUTI model. Our work will be organized in three research directions. First, we aim at analyzing how Tranus is used by local agencies. Then, a comparison between the Tranus implementation and use for the cities of Grenoble (France) and Caracas (Venezuela) is planned. And finally semi-automatic calibration tools will be developed, and an uncertainty and sensitivity analysis will be performed.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Genopole initiatives

Participants: Olivier Collin, Delphine Naquin, Aurélien Roult.

We benefit from the strong implication of the GenOuest Ressource center in the regional Genopole to have long-term research and development relationships with most of laboratories in Brittany involved in molecular biology.

As a technological platform belonging to Biogenouest, the Life Science network of the West of France, the bioinformatics platform is funded by the Brittany Region. This funding allowed the creation of two short term contract positions, shared with other technological platforms:

- A sequencing facility: creation of a bioinformatics environment for the management and analysis of Next Generation Sequencing data,
- A proteomic facility: system and network administration, managing a small cluster and providing expertise for an upgrade of the computational and network infrastructure.

This alliance with other facilities proved to be a very good way to reinforce bonds and cooperation, giving birth to new research subjects both within the Symbiose team and biological team.

8.1.2. Partnership with INRA


We have a strong and long term collaboration with biologists of INRA in Rennes: Bio3P, APBV and SENAH units. This partnership concerns both service and research activities and is acted by the hosting of two ingineers (F. Legeai, F. Moreews) and by the co-supervision of three post-doctorants and one PhD student. In particular, the collaboration with the APBV team, including the co-supervision of a post-doc, are built upon an INRA project PEAPOL including an industrial partner, Biogemma.

8.2. National Initiatives

8.2.1. ANR contracts

8.2.1.1. BIOWIC

Participants: Dominique Lavenier, Olivier Collin, Rumen Andonov, François Moreews, Jonathan Piat, Guillaume Rizk.

The BioWIC project aims to speed up both the design and the execution of bioinformatics workflows. It is funded by ANR call ARPEGE and coordinated by D. Lavenier from Jan. 2009 to June 2012. [http://biowic.inria.fr/](http://biowic.inria.fr/)

8.2.1.2. LEPIDOLF

Participants: François Coste, Fabrice Legeai, Jacques Nicolas, Andres Burgos, Pavel Senin.

The LEPIDOLF project aims at better understanding olfactory mechanisms in insects. The goal is to establish the antennal transcriptome of the cotton leafworm Spodoptera littoralis, a noctuid representative of crop pest insects. It is funded by ANR call Blanc and coordinated by E. Jacquin-Joly from UMR PISC (INRA) from 2009 to 2012.
8.2.1.3. MAPPI

**Participants:** Dominique Lavenier, Pierre Peterlongo, Guillaume Chapuis, Rayan Chikhi, Nicolas Maillet.

The MAPPI project aims to develop new algorithms and Bioinformatics methods for processing high throughput genomic data. It is funded by ANR call COSINUS and coordinated by M. Raffinot (LIAFA, Paris VII) from Oct 2010 to Dec. 2013.

8.2.1.4. PELICAN

**Participants:** Olivier Collin, François Coste, Anthony Breataudeau, Andres Burgos.


8.2.1.5. ECS

**Participant:** Olivier Collin.

The ECS project explores cooperation in plant symbioses. It provides new insights on how plant-microbe interactions shape the ecological processes and evolutionary trajectories of natural and agricultural ecosystems. This project seeks also to identify new symbiotic partners for plants. It is funded by ANR (Systerra) and coordinated by P. Vandenkoornhuyse from UMR 6553 (CAREN) from 2010 to 2013. [http://ecs-project.univ-rennes1.fr/news.php](http://ecs-project.univ-rennes1.fr/news.php)

8.2.1.6. BIOTEMPO

**Participants:** Anne Siegel, Jérémie Bourdon, François Coste, Jacques Nicolas, Michel Le Borgne, Geoffroy Andrieux, Sylvain Prigent, Santiago Videla, Andres Aravena.

The BioTempo project aims at developing some original methods for studying biological systems. The goal is to introduce partial quantitative information either on time or on component observations to gain in the analysis and interpretation of biological data. Three biological applications are considered regulation systems used by biomining bacteria, TGF-beta signaling and initiation of sea-urchin translation. It is funded by ANR Blanc (SIMI2) and coordinated by A. Siegel from 2011 to 2014. [http://biotempo.genouest.org/wiki.php/Accueil](http://biotempo.genouest.org/wiki.php/Accueil)

8.2.2. Programs from research institutions

**Participants:** Anne Siegel, François Coste, Olivier Collin, Charles Deltel, Dominique Lavenier, Michel Le Borgne, Claire Lemaitre, Pierre Peterlongo, Jérémie Bourdon, Pavlos Antoniou, Andres Burgos, Guillaume Chapuis.

- **Alcovna** The Alcovna project aims to explore possibilities of extracting information among possibly huge sets of reads without reference genome and avoiding to assemble the data. It is funded by INRIA ARC call and coordinated by P. Peterlongo from oct. 2009 to sept. 2011. [http://alcovna.genouest.org](http://alcovna.genouest.org)

- **BioManyCores** The BioManyCores project aims to develop a library of bioinformatics softwares implemented on manycore structures such as GPU. It is funded by INRIA ADT call and supervised by J.S. Varré in Sequoia Team in Lille. [http://www.biomanycores.org/](http://www.biomanycores.org/)

- **ParaQtlMap** The ParaQtlMap project is a join initiative from EPI Symbiose and Genticque Animale, to design high performance software for detecting quantitative trait loci. It is funded by INRIA/INRA call and coordinated by D. Lavenier (EPI Symbiose) and P. Leroy (GA INRA) from oct. 2010 to sept. 2012. [https://qgp.jouy.inra.fr/index.php?option=com_content&task=view&id=17&Itemid=28](https://qgp.jouy.inra.fr/index.php?option=com_content&task=view&id=17&Itemid=28)

- **Protomata** The protomata project aims at developing a software for modeling proteins families with automatas. It is funded by INRIA ADT call (2010-2011) and supervised by F. Coste.

- **QuantOursin** The QuantOursin project aims at developing modeling tools based on probabilistic framework and average analysis, and apply then to the initiation of urchin translation. It is funded by a PEPS program at CNRS and coordinated by A. Siegel from april. 2010 to december. 2012. [http://quantooursin.genouest.org/wiki.php/Accueil](http://quantooursin.genouest.org/wiki.php/Accueil)
8.2.3. Transfert and service ressources - GenOuest ressource center

Participants: Olivier Collin, Olivier Sallou, Charles Deltel, Anthony Bretoudeau, Delphine Naquin, Aurélien Roult, Romaric Sabas, Claudia Hériveau.

- **GRISBI** The project intends at developing a production grid dedicated to bioinformatics, by gathering computational ressources of six french ressource centers. It is funded by IBISA and coordinated by C. Blanchet (IPCP Lyon) from 2009 to 2011. [http://www.grisbio.fr](http://www.grisbio.fr)

- **DrMotifs** is a project dedicated to develop tools for pattern discovery and research. The resource integrates the tools in a workflow plugged on different databases in order to provide a user friendly tool geared toward motif discovery. It is funded by IBISA and coordinated by O. Collin (Symbiose) from 2010 to 2011. [http://drmotifs.genouest.org](http://drmotifs.genouest.org)

- **BioMaj** The project aims at developing a workflow engine dedicated to data synchronization and processing. The Software automates the update cycle and the supervision of the locally mirrored databank repository. It is funded by Inria ADT program from 2009 to 2011 and coordinated by O. Collin. [http://biomaj.genouest.org](http://biomaj.genouest.org)

- **Inria Biosciences Resources** This new project (recruitment of an engineer in november) is focused on the different ways to improve the visibility of Inria’s bioinformatics team software production. To achieve this goal, a new web resource will be built. This resource will allow end-users to test and evaluate the new bioinformatics tools created by Inria. It is funded by INRIA ADT program from 2011 to 2013, it involves 8 research teams and is coordinated by Symbiose (Jacques Nicolas and Olivier Collin).

8.3. International Initiatives

8.3.1. INRIA Associate Teams

8.3.1.1. INTEGRATIVEBIOCHILE

Title: Bioinformatics and mathematical methods for heterogeneous omics data

INRIA principal investigator: Anne Siegel

International Partner:

- **Institution**: University of Chile (Chile)
- **Laboratory**: University of Chile, CMM

Duration: 2011 - 2013

See also: [http://www.irisa.fr/symbiose/people/asiegel/EA/](http://www.irisa.fr/symbiose/people/asiegel/EA/)

IntegrativeBioChile is an Associate Team between INRIA project-team "Symbiose" and the "Laboratory of Bioinformatics and Mathematics of the Genome" hosted at CMM at University of Chile. The Associated team is funded from 2011 to 2013. The project aims at developing bioinformatics and mathematical methods for heterogeneous omics data. Within this program, we funded long-stay visitings in France to initiate long-term research lines, in complement to short visit funded by and inria-conycit program.

- **Reconstruction of regulatory networks**. This research line was developed within the visits of A. Aravena and A. Maass in March 2011 (funded by conycit-inria and by a mobility grant from UEB). It was pushed further during the visit of J. Bourdon in October 2011 and A. Siegel in November 2011 in Chile.

- **Reconstruction and study of metabolic network with reduction methods**. This research line was initiated during the one-month visit of Marko Budinich (engineer) in Rennes in April 2011. It was pushed further with visits from french researchers in Santiago funded by Inria-Conycit program (D. Eveillard and S. Prigent).

- **Detection of structural variations in genomes** This research line was studied during the one-month visit of Alex Di Genova (engineer) in Rennes in May 2011.
8.3.2. INRIA International Partners

- **CWI, The Netherlands**: In 2011 we have been collaborating very actively with the Algorithmic computational biology from CWI Life Sciences, The Netherlands in the domain of protein structure comparison. Inken Wohler, a PhD student from CWI visited Symbiose for 6 months partially supported by Inria internship grant. Two papers have been published in the framework of this cooperation [31], [22].

8.3.3. Visits of International Scientists

8.3.3.1. Internship

- Andres Aravena, from CMM (Chile) received a 3 months Mobility Grant from "University Européenne de Bretagne" to visit the Symbiose team between April and July.
- Inken Wohlers, from CWI (Amsterdam The Netherlands) received a 6 months Inria internship and visited Symbiose from December 2010 to May 2011.

8.3.4. Participation In International Programs

8.3.4.1. Chile. Inria-Conicyt 2011-12

Partner: University of Chile, Laboratory of Bioinformatics and Mathematics of the Genome, Chile.

Title: Integrative Biomining

Financial support: Conicyt-Inria program 2011-12

INRIA principal investigator: Anne Siegel

The project wishes at developing methods combining combinatorial and constraint-based approaches with probabilistic/optimization approaches to integrate and explore heterogeneous, multi-scale and large-scale data produced in molecular biology.

Within the project, the following visits were funded (A) 2 months visit in Rennes (A. Aravena, PhD student, February-March 2011) (B) 3 weeks visit in Rennes (A. Maass, professor, March 2011) (C) 15 days visit in Santiago de Chile (A. Siegel, assistant professor, July 2011). (D) 15 days visit in Santiago de Chile (F. Coste, junior researcher, October 2011) (E) 1 month visit in Santiago de Chile (S. Prigent, PhD student, November 2011).

8.3.4.2. Argentina - MinCYT-Inria 2011-12

Partner: Universidad Nacional de Córdoba, Grupo de Procesamiento de Lenguaje Natural (PLN), Argentina.

Title: Modélisation linguistique de séquences génomiques par apprentissage de grammaires

Financial support: MinCYT-Inria program 2011-12

The project aims at developing new grammatical inference methods to learn automatically linguistic models of genomic sequences.

Within the project, the following visits were funded (A) 15 days visit in Cordobà (F. Coste, junior researcher, June 2011) (B) 1 month visit in Rennes (R. Carrascosa, PhD student, August 2011) (C) 15 days visit in Rennes (G. Infante-Lopez, professor, November 2011).

8.3.4.3. Germany. Egide Procope Program 2011-12

Partner: Postdam university, Institut fu’r Informatik Wissensverarbeitung und Informationssysteme, Germany

Title: Querying Biological Systems with Answer Set Programming.

Financial support: Egide Procope Program 2011-12

The project aims at developing new methods for constructing and querying biological networks with a new constraint-based programming (answer set programming) mastered in Postdam university.
Within the project, the following visits were funded (A) 1 week visit in Rennes (S. Thiele, PhD student, May 2011) (B) 15 days visit in Postdam and Heidelberg (P. Blavy, PhD student, June 2011) (C) 1 week visit in Rennes (T. Schaub, professor, October 2011) (D) 1 week visit in Rennes (M. Gebser, Post-doc, October 2011) (E) 1 week visit in Postdam (J. Nicolas, senior researcher, December 2011) (F) 1 week visit in Postdam (S. Videla, PhD student, December 2011) (G) 1 week visit in Postdam (V. Wurcher, PhD student, December 2011)
6. Partnerships and Cooperations

6.1. National Grants

6.1.1. Agropolis computational plant seminar
Participants: Yann Guédon, Christine Granier [INRA, LEPSE], Laurent Laplaze [IRD, DIAPC].
Funding: Agropolis foundation (Contractor for Virtual Plants: CIRAD. From 2008 to 2011)
In the context of the creation of a world-level pole on plant science in the region Languedoc-Roussillon,
we organize a monthly seminar and a yearly workshop at Agropolis (see http://www.plantnum.agropolis.fr).
The 2011 two-day workshop was devoted to Models at whole plant scale. The invited speakers were
Winfried Kurth (University of Göttingen), Mathieu Javaux (Université Catholique de Louvain),
Yann Guédon, Renaud Bastien (INRA, PIAF), Frédéric Mothe (INRA, LERFoB), Annikki Mäkelä (University of Helsinki),
David Da Silva (UC Davis), Michaël Chelle (INRA, EGC), Jochem B. Evers (Wageningen University),
Brian Enquist (University of Arizona, Tucson), François Tardieu (INRA, LEPSE). The seminar is organized by Yann
Guédon, Christine Granier (INRA, LESPE) and Soazig Guyomarc’h (Montpellier 2 University, DIADE) with
the support of Agropolis International and Agropolis Foundation.

6.1.2. OpenAlea
Participants: Christophe Pradal, Christophe Godin, Christian Fournier [INRA, LEPSE].
Funding: Agropolis foundation (Contractors for Virtual Plants: CIRAD and INRIA from 2009 to 2012)
The aim of this project is to foster the development and the national and international diffusion of the
platform OpenAlea. This opensource platform provides an easy-to-use environment for plant modelers through
a visual programming interface to efficiently use and combine models or computational methods from
different scientific fields in order to represent, analyze and simulate complex plant systems at different scales,
from meristems to plant canopy. OpenAlea makes it possible to assemble highly reusable, heterogeneous
components. The central point of its architecture is to allow to integrate existing components or modules
developed by different teams without rewriting them. These components are developed in multi-languages
like C, C++, Fortran or Java as well as Python. Work comprises development of standard data structures,
deployment tools, documentation, training, software engineering, user interface, ...

6.1.3. vTissue
Participants: Eric Moscardi, Christophe Pradal, Christophe Godin, Grégoire Malandain [INRIA, Asclepios].
Funding: INRIA ADT (Contractors for Virtual Plants: INRIA from 2009 to 2011)
The goal of this project is to integrate in a single software platform all the software tools and algorithms
that have been developed in various projects about meristem modeling in our teams. More precisely, we aim at
building 3D models of meristem development at cellular resolution based on images obtained with confocal or
multiphoton microscopy. This set of components will be used by biologists and modelers making it possible to
build such meristem structures, to explore and to program them. This platform is embedded in the OpenAlea
framework and is based on the imaging components of the platform MediINRIA.
Partners: EPI Asclepios, RDP ENS-Lyon/INRA, PHIV CIRAD

6.1.4. Phenomena
Participants: Christophe Pradal, Christian Fournier [INRA, LEPSE], Benoît de Solan [Arvalis/INRA,
Avignon], Frédéric Baret [INRA, UMMAH], Elmer Ccopa-Rivero [INRA, UMMAH], Bruno Andrieu [INRA,
EGC], Michel Chelle [INRA, EGC].
Funding: Agropolis foundation (Contractors for Virtual Plants: CIRAD (INRIA sub-contractor) from 2010 to 2012)

The aim of this project is to combine a 4D plant model with a functioning model as a support to improve field high throughput phenotyping with remote sensors. This is a critical need to enhance interpretation of large amount of genotypic data made available by sequencing methods in constant improvement. Collecting more frequent and more accurate plant and stand measurements may lead to a better characterization of cultivar response to stresses.

Plant breeding appears to be a major component in the way to solve the new challenges that agriculture in Mediterranean areas is facing. New techniques allowing to access specific traits of cultivars have to be developed based on non destructive and rapid measurements such as those offered by close range remote sensing known as proxidetection.

This work is based on two existing models, the NEMA model for nitrogen dynamic between leaves and the Alinea.ADEL architectural model. Implementation use the modeling platform OpenAlea, dedicated to functional structural modeling of plants. The coupled model is then be used to simulate reflectance and gap fraction with a radiative transfer model (Baret et al., 2007).

6.1.5. Fruit3D
**Participants:** Mik Cieslak, Frédéric Boudon, Christophe Godin, Nadia Bertin [PSH, Avignon].

Funding: Agropolis foundation (Contractor for Virtual Plants: INRA, from 2009 to 2011)

The aim of this project is to develop a virtual tomato that contains the geometrical description of a growing fruit, physiological models (for sugar and hormone transfers) and mechanical model. The project gathers the competences of plant modelers, physicists and ecophysiologists. Physical and biological laws involved in tissue differentiation and cell growth, in relation to fruit growth and compartmentalization, and a number of related traits of quality (e.g. size, composition and texture) are modeled and integrated within the virtual tomato. Nuclear Magnetic Resonance (NMR) and Magnetic Resonance Imaging (MRI) techniques are used to provide an in vivo validation of the model by non invasive measurements.

Partners: PSH, INRA, Avignon; LCVN, IES, Université Sud de France, Montpellier.

6.1.6. PlantScan3D
**Participants:** Frédéric Boudon, Chakkrit Preuksakarn, Jean-Baptiste Durand, Christophe Godin, Christian Fournier [INRA, LEPSE].

Funding: Agropolis foundation (Contractor for Virtual Plants: CIRAD, From 2009 to 2011)

Automatic acquisition of plant phenotypes, and in particular of architecture phenotypes, constitutes a major bottleneck of the construction of quantitative models of plant development. Recently, 3D Laser Scanners have made it possible to acquire 3D images on which each pixel has an associated depth corresponding to distance between camera and the pinpointed surface of the object. The objective of this project is to develop the use of laser scanner for plant geometry reconstruction. For this, we develop methodologies for the automation of numerical 3D acquisition of vegetal structures of different sizes, and new methods for the reconstruction of parsimonious geometrical and structural models usable in agronomic and biological contexts.

Partners: AFEF Team, UMR DAP, UMR LEPSE (Montpellier), UMR PIAF (INRA Clermont Ferrand), UMR URPI3F (Inra Lusignan), EPI Galaad (INRIA Sophia Antipolis), EPI Evasion (INRIA Grenoble). University of Helsinki, Finland.

6.1.7. GeneShape
**Participants:** Jérôme Chopard, Michael Walker, Etienne Farcot, Christophe Godin.

Funding: ANR (Contractor for Virtual Plants: INRIA, From 2009 to 2011)
In this project, we propose to develop a complex systems approach to study the development of multi-cellular organisms. We have chosen two distant biological systems. One is the embryo of an ascidian organism, Ciona intestinalis and the other is the female reproductive organ of a flowering plant, Arabidopsis thaliana. These two systems are very different a priori. However, there also have striking morphological similarities. Development of both systems involves the spatial control of cell growth and proliferation, while at a higher scale morphogenetic processes such as organ outgrowth or tissue invagination and folding occur. From a fundamental point of view it will, therefore, be very interesting to study how these distant organisms have solved different problems (different mechanical constraints, different number of cells, different timing) to create morphologically similar shapes.

Partners: ENS-Lyon; P. Lemaire, CRBM, Montpellier.

6.2. International Bilateral Relations

6.2.1. ANR-BBSRC Grant

Participants: Christophe Godin, Jan Traas, Etienne Farcot, Yassin Refahi, Frédéric Boudon, Andrew Bangham [Univ. East Anglia], Enrico Coen [John Innes Center, UK], Robert Sablowski [John Innes Center, UK], François Parcy [CNRS].

(Contractor for Virtual Plants: INRIA. From September 2008 to September 2011)

*Flower Model: Modeling growth and gene regulation in floral organs* is a project funded by the ANR-BBSRC programme System Biology (SysBio). Systems biology aims to explain and predict the behavior of complex biological systems by quantitative analysis and modeling of the interactions between all the relevant components. An important challenge for the years to come is how to integrate the approaches used for growth analysis at different stages with the role of regulatory genes to produce predictive models of floral organ growth and patterning. To address this question, this project brings together leading UK and French teams with complementary expertises on imaging, floral development and quantitative modeling, to focus on a comparative analysis of sepal and petal growth in *Arabidopsis thaliana*. We use live imaging and sector analysis to produce quantitative models of growth for these organs. We then integrate information on regulatory genes with spatial information to produce in silico models of the regulatory network controlling sepal and petal development. The results of the project consist of:

- Capturing quantitative data on sepal and petal morphogenesis
- Analyzing and model the regulatory networks underlying sepal and petal development
- Linking morphogenesis to regulatory networks
- Creating an integrated database of complex datasets

6.2.2. ERASysBio+ iSAM

Participants: Christophe Godin, Etienne Farcot, Jan Traas, Teva Vernoux, James A.H. Murray [Univ. Cardiff, UK], Yrjö Helariutta [Univ. Helsinki, Finland].

(Contractor for Virtual Plants: INRIA. From September 2008 to September 2011)

This project essentially aims at improving our knowledge of shoot apical meristem, and more specifically the combined action of auxin and cytokinin, using a systems biology approach. It is part of a wider program, the ERASysBio initiative, a consortium of European funding bodies, ministries and project management agencies. The purpose of this consortium is to develop fundamental and strategic collaboration in the funding of systems approaches to biological research. The iSAM project is one of the 16 transnational consortia that have been selected out of 51 proposals; in total they comprise 85 working groups from 14 countries. Four partners are involved in iSAM: the group of J. Murray will focus on mutants of cell cycle regulation, the group of Y. Helariutta is specialized in several aspects of cytokinin regulation, while the group of J. Traas in Lyon provides input regarding auxin regulation and transport, and Virtual Plants is in charge of the modeling aspects, in synergy with the three other groups.
6.2.3. Other bilateral relations

There is currently an active connection with the group of Malcolm Bennett, at the Centre for Plant Integrative Biology (CPIB) in Nottingham. The CPIB invests in the development of OpenAlea at the tissue level. In this context, both groups have regular meetings and visio conference to progress jointly on the definition of the platform. In particular, C. Godin, M. Walker and E. Farcot went to a 1-week meeting on tissue data-structure definition and several researchers from CPIB came to Montpellier to continue this work and start implementation.

The team of Pr. Prusinkiewicz at the University of Calgary (Canada) is an associated team of Virtual Plants. In this context, F. Boudon spent 5 weeks in Calgary, and Wojtek Palubicki, PhD student, came for a 3 months visits to work on plant architecture simulation models.

Yann Guédon is working with Claudia Negron (PhD student), Anna Davidson (PhD student), David Da Silva (post-doctoral fellow) and Ted DeJong (University of California, Davis) on the analysis of the development and the branching and axillary flowering structures of peach and almond shoots. Claudia Negron, Anna Davidson, David Da Silva and Ted DeJong visited the Virtual Plants and the AFEF teams (Evelyne Costes) in September 2011.

6.3. International Initiatives

6.3.1. INRIA Associate Teams

The team of Pr. Prusinkiewicz at the University of Calgary (Canada) has been an associated team of Virtual Plants from 2009 to 2011. see http://www-sop.inria.fr/virtualplants/wiki/doku.php?id=projects:eqass-vp-uc.

6.3.2. Visits of International Scientists

Farah Ben-Naoum, from the University of Sidi Bel Abbes, Algeria, visited the team during one month to work with Christophe Godin on the application of evolutionary algorithms to the compression of tree structures.

6.3.3. Participation In International Programs

During the period October 2011-January 2012, E. Farcot is a visitor at the Memorial University of Newfoundland (MUN), St. John’s, Canada, to work with Pr. Yuan Yuan, in the Mathematics and Statistics department. This visit was funded by the “Explorateur” program.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. TransIRMf project

Participants: Christian Barillot, Jean-Yves Gauvrit, Jean-Christophe Ferré, Elise Bannier, Camille Maumet, Isabelle Corouge.

duration: 18 months, from 01/10/2010

The objective of this project is to set up and validate acquisition and data processing pipelines for metabolic and functional MRI. Acquisition techniques comprise innovative block design and event related paradigms based on various stimuli (visual, auditory) and use various MRI sequences (BOLD, ASL). Paradigms were selected to cover a large scope of potential applications. The protocol imaging namely includes a BOLD fMRI resting state paradigm, an n-back working memory paradigm for BOLD fMRI, as well as and for the first time, for functional ASL. An emotional prosody recognition task was implemented, also for the first time, in an event related BOLD fMRI context. Data were acquired on 30 healthy subjects. Processing of these data is in progress based on inhouse pipelines (e.g., template construction using DARTEL, PVE correction for ASL data). This grant was awarded in collaboration with Biotrial within the CRITT-Santé Bretagne program.

8.1.2. CPER 2007-2013, NeurInfo Platform

Participants: Elise Bannier, Isabelle Corouge, Jean-Christophe Ferré, Jean-Yves Gauvrit, Christian Barillot.

duration: 7 years, from 01/01/2007

Visages is the founding actor of a new experimental research platform which has just been installed August 2009 at the University Hospital of Rennes. The University of Rennes 1, Inria, Inserm for the academic side, and the University Hospital of Rennes and the Cancer Institute “Eugene Marquis” for the clinical side, are partners of this neuroinformatics platform called "NeurINFO" (http://www.neurinfo.org). This platform concerns the in-vivo human imaging for clinical research and neuroinformatics especially in the context of CNS pathologies. A new research 3T MRI system has been acquired in summer 2009 in order to develop the clinical research in the domain of morphological, functional, structural and cellular in-vivo imaging. Visages and its partners in the Neurinfo project are committed to use this new research platform for developing new regional, national and international collaborations around fundamental and applied clinical research projects dealing with in-vivo medical imaging. In the next three years, additional equipments will arrive among them are two PET labs for experimentation of new ligands for molecular imaging, an in vivo confocal microscope for interventional imaging in neurosurgery and large computing facilities for storage and processing of large collection of data. This new platform has been supported under the “Contrat de Projets Etat-Région” (C. Barillot is the PI) and have received a total amount of 5.1 Meuros for the period of 2007–2013. A specific technical staff to conduct this platform is under recruitment in order to make this new environment open to a large scientific and clinical community.

8.1.3. COREC projects

Participants: Elise Bannier, Isabelle Corouge, Jean-Christophe Ferré, Jean-Yves Gauvrit, Christian Barillot.

COREC is the "COnmite de REcherche Clinique" of the University Hospital of Rennes. This comity proposes an annual project funding in the limit of 30keuros per project. In 2011, the Neurinfo platform as an initiative action for clinical research project emergence accompanied the COREC call by financially supporting the imaging part of the projects up to 50 MRI hours, ie 30keuros. Two projects were selected by the COREC in this context.
8.1.4. Emotional prosody recognition in fMRI and vulnerability to suicide

**Participants:** Christian Barillot, Elise Bannier, Isabelle Corouge, Jean-Yves Gauvrit, Jean-Christophe Ferré.

This project, initiated by the Psychiatry Department of the University Hospital of Rennes, is a clinical research study looking for correlations between cerebral activity observed with fMRI during an emotional prosody recognition task in a cohort of depressed patients and at risk for suicide. This study will include 3 groups of 20 patients: i) depressed patients with recent attempted suicide, ii) depressed with attempted suicide history, iii) depressed with no attempted suicide history. fMRI data will be acquired at the Neurinfo platform, their processing and interpretation will be performed in close collaboration between the Psychiatry Department and the VisAGEs team.

8.1.5. DIMITRI: Evaluation of the test object DIMITRI to measure diffusion restriction in full body MRI in bone infiltration

**Participant:** Elise Bannier.

Initiated by the Radiology Department of the University Hospital of Rennes, this clinical research study will evaluate the reproducibility of the diffusion restriction quantification methods. The experimental framework will rely on the test object DIMITRI and will consider inter-raters variability (reliability), intra-MRI scanner variability (repeatability) and inter-MRI scanners variability. Clinical applications of this work concern the use of diffusion restriction as a biomarker for myeloma diagnosis and follow-up.

8.2. National Initiatives

8.2.1. Cardiac imaging project

**Participants:** Jean-Yves Gauvrit, Christian Barillot, Elise Bannier.

**duration:** from 04/10/2011

A proposal led by the Cardiology Department of the University Hospital of Rennes in collaboration with the Radiology Department, the University of Rennes 1 and the Neurinfo platform was granted by the Fédération Française de Cardiologie in order to acquire an advanced MRI software specific to cardiac imaging ("Advanced Cardiac #3T"). This software, installed in October 2011, will enable the development of local cardiac imaging projects in close collaboration with cardiologists and cardio-radiologists. It will also increase the capacity of the Neurinfo platform to take part into external clinical research studies involving cardiac imaging.

8.2.2. Apathy in depression: neural basis from perfusion and functional MR

**Participants:** Jean-Christophe Ferré, Christian Barillot, Isabelle Corouge, Elise Bannier.

**duration:** 18 months from 01/07/2011

Depression is becoming a major cause of handicap due to its relapses and chronicity. The main risk factors for relapse are residual symptoms like apathy. Apathy is defined as a decrease in motivation and expresses itself on the behavioral, cognitive and emotional levels. However, the neural basis of apathy remain unknown. This project proposes 1) to use Arterial Spin Labeling to characterize the neural basis of apathy in the major depressive index episode (MDIE), 2) to use an fMRI emotional recognition task (the Variable Attention Affective Task) to characterize apathy involved brain structures dysfunction in the MDIE. 45 subjects will be recruited: i) 15 apathetic subjects with MDIE, ii) 15 non apathetic subjects with MDIE, iii) 15 healthy subjects. This research program was initiated by the Psychiatry Department of the University Hospital of Rennes and is built on collaborations between the Psychiatry and Neuroradiology Departments of the University Hospital of Rennes, the URU425 Research Unit and the VisAGEs team. It is funded by the "Fondation de l’Avenir pour la Recherche Médicale Appliquée".
8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: COST
Project acronym: AID (oc-2010-2-8615)
Project title: Arterial spin labelling Initiative in Dementia
Acceptation date: 18/05/2011
Coordinator: X. Golay, UCL, London, UK
Other partners: Ghent University (BE), Liege University (BE), Hospital Cantonal de Geneve (CH), Fraunhofer MEVIS (D), Freiburg University (D), Max Planck Institute for Human Cognitive & Brain Sciences (D), Glostrup Hospital (DK), Hospital Santa Creu I Sant Pau (ES), Universidad Rey Juan Carlos (ES), University of Navarra (ES), INSERM U836 Grenoble (FR), University of Rennes I (FR), Centro San Giovanni di Dio - Fatebenefratelli (IT), Fondazione Instituto Neurologico Besta (IT), Leiden University Medical Center (NL), UMC Utrecht (NL), VU University Medical Centre (NL), Instituto Superior Técnico (PT), University of Porto (PT), Lund University Hospital (SE), Uppsala University Hospital (SE), Skane University Hospital (SE), Bogazici University (TR), King’s College London (UK), University College London (UK), University of Nottingham (UK), University of Oxford (UK)

Abstract: Dementia is a major clinical challenge with care costs approaching 1% of global GDP. Recent estimates suggest that delaying disease onset by 5 years would halve its prevalence. As new disease-modifying treatments will be specific to causative diseases, expensive and bear significant side effects, early diagnosis of dementia will be essential. Current diagnostic criteria include the use of image-based biomarkers using radiotracers. The AID Action aims at coordinating the development of an alternative and cost-effective tool based on an MRI technique, Arterial Spin Labelling (ASL), to obtain reproducible brain perfusion measurements in dementia patients by bringing together scientists and clinicians from across Europe through the flexibility of the COST mechanism. The scientific program is centered around four work packages and three workgroups aiming at developing standards, improving the reliability of the technique and as establishing it as a possible clinical trial outcome measure. Development of MRI methods, post-processing tools, protocols of cross-validation, statistical analyses and launch of clinical and comparative studies will be undertaken. The main benefit of this Action will be to provide a cost-effective alternative to radiotracer-based biomarkers, and help care providers throughout Europe balancing the need for early diagnosis of dementia with the necessary healthcare cost containment.

8.3.2. Major European Organizations with which Visages has followed Collaborations

Institution: European Insitute for Biomedical Imaging Research (EIBIR)
Role: Participation to the steering committee of the EIBIR’s Biomedical Image Analysis Platform:
Through training, collaborative projects, and drafting a roadmap towards improved interoperability of and access to biomedical image analysis tools, EIBIR’s Biomedical Image Analysis Platform is taking an active role in shaping the future of biomedical imaging research.

8.4. International Initiatives

8.4.1. INRIA Associate Teams

8.4.1.1. NEUROMIME

Title: Objective Medical Image Methods Evaluation for Neurological and Neurosurgical Procedures
INRIA principal investigator: Christian Barillot
International Partner:
Institution: McGill University (Canada)
Laboratory: Montreal Neurological Institute

Duration: 2006 - 2011

See also: https://www.irisa.fr/visages/collaborations/neuromime

The goal of this INRIA associated team is to combine the respective research efforts we have recently conducted between the VisAGeS and IPL teams, and thus benefit from the resulting cross-fertilization in order to prolong the efforts which just start to give significant deliverables. We aim at addressing specific aspects of medical image processing for the purpose of neurological disease analysis and their treatment through surgery. Both teams have now significant experience in developing together research tools or experimental framework aiming at:

- improving neurosurgical practice through pre-operative planning, intra-operative guidance and imaging of brain deformations through the establishment of image processing workflows and validation benchmarks;
- improving neurological exploitation of the spatio-temporal and multiparametric MRI data produced in the context of multiple sclerosis and more specifically focal MS-lesions.

8.4.2. Visits of International Scientists

- Prof. Charles Guttmann, Director of the Center for Neurological Imaging at Brigham and Women’s Hospital and Assistant Professor in Radiology at Harvard Medical School. Dec. 15-16, 2011.
- Dr. Alexander Hammers, Chair of Excellence in Functional Neuroimaging at the Neurodis Foundation in Lyon, France, Visiting/Honorary Reader at Imperial College London and at the Institute of Neurology, UCL, London. Oct 19-20, 2011.
- Dr. Xiaojun Chen, Laureate of the France Talent Innovation, Associate Professor, Shanghai Jiao Tong University, China. Aug 28th, 2011.
- Prof. Daniel RUECKERT, Professor of Visual Information Processing and head of the Biomedical Image Analysis group, Department of Computing, Imperial College London, UK. Jan 31st, 2011.
- Dr. Bertrand Thirion, Head of the Parietal project Team, Inria Saclay, Neurospin/CEA. Jan 31st, 2011.

8.5. National initiatives

8.5.1. ANR USComp

Participants: Jan Petr, Christian Barillot.

We participate in the US comp project, headed by Lagadic project. UScomp aims at developing methods to compensate in real-time the soft tissue motion. Organs are imaged with an ultrasound probe held by a robotic arm. Within the project, we have contributed to develop a real-time ultrasound processing thanks to a GPU implementation of an adapted NL-means approach, the implementation of a graph cut segmentation method being developed through the post doc position of Jan Petr.

8.5.2. ANR “Neurological and Psychiatric diseases“ NUCLEIPARK

Participants: Christian Barillot, Sylvain Prima, Olivier Commowick.

This three-year project, led by CEA/NEUROSPIN (Cyril Poupon) in Saclay, will start in fall 2009. It involves a collaboration with Visages and Odyssee INRIA project-teams and INSERM La Pitié-Salpêtrière, Paris. Its goal is to study high field MR imaging (7T and 3T) of the brainstem, the deep nuclei and their connections in the parkinsonian syndromes, with applications to prognosis, pathophysiology and improvement of therapeutic strategies methodological solutions. Our contribution in this project is on processing of diffusion imaging and on study of cortical differences between the different populations.
8.5.3. ANR Cosinus VIP  
**Participants:** Bernard Gibaud, Olivier Luong, Germain Forestier, Christian Barillot.  

VIP is collaborative project supported by ANR "Conception and Simulation"; it was accepted in 2009 (around 1 million euros). VIP aims at building a computing environment enabling multi-modality, multi-organ and dynamic (4D) medical image simulation, using GRID infrastructure. The goal is to integrate proven simulation software of the four main imaging modalities (MRI, US, PET and X-Ray/CT), and to cope interoperability challenges among simulators. The partners are CREATIS in Lyon (main contractor, Principal Investigator: Tristan Glatard), UNS-I3S in Nice, CEA-LETI in Grenoble and MAAT-G Maat G, a spanish company. The role of VISAGES in this project concerns primarily Task 1.1 and Task 3.3, focusing respectively on ontologies development and application to multiple sclerosis images simulation. This grant serves as support for the positions of Olivier Luong (PhD student) and Germain Forestier (post-doc).
ACES Project-Team (section vide)
8. Partnerships and Cooperations

8.1. Local Initiatives

8.1.1. INRIA ADT CALICO

Participants: Laurence Duchien, Antonio de Almeida Souza Neto, Anne-Françoise Le Meur.

The CALICO ADT (Action de Développement Technologique) is an ADT local to the INRIA Lille Nord Europe Center that aims to maintain and develop the CALICO framework (cf. section 5.2). The architecture of CALICO is based on a co-evolution approach where the model level enables software architects to describe and reason on application properties, and the runtime level holds the running application executed on a given platform. CALICO is generic and extensible in terms of target platforms, analyses at the model level, etc. This particularity makes CALICO a framework that could federate several of the ADAM research works and integrate external contributions. Antonio de Almeida Souza Neto (newly graduated engineer) has been recruited in the context of this INRIA ADT.

8.1.2. INRIA ADT UbInnov

Participants: Laurence Duchien, Christophe Demarey, Clément Quinton.

The UbInnov ADT (Action de Développement Technologique) aims at building a Software Product Line (SPL) for mobile applications named AppliDE reusing the technologies developed in the ADAM project-team. UbInnov aims to industrialize AppliDE, a software product line for mobile applications (iPhone, Android). With AppliDE, the development time of a mobile application is significantly reduced thanks to an automatic generation of code. The generated code supports required features from the device, such as geolocation, camera or connection to external services. Clément Quinton (INRIA ADAM New Graduate Engineer) has been recruited to achieve this task. The results have been published in [40].

8.1.3. INRIA ADT Adapt

Participants: Gwenael Cattez, Christophe Demarey, Philippe Merle.

The Adapt ADT (Action de Développement Technologique) is a local ADT of the Inria Lille - Nord Europe Center and aims at building a demonstrator of our ADAM software technologies in the application domain of smart digital homes. Firstly, this demonstrator will show adaptive and reflective capabilities of FraSCAti 5.4, i.e., supporting various implementation languages (e.g., Java, WS-BPEL, scripting languages, template technologies) to develop business components, supporting various remote communication protocols (e.g., SOAP, REST, JMS, JGroups) to access and expose services, supporting various non functional properties, deploying business components on demand, and reconfiguring business applications/components/services at runtime. Secondly, these capabilities will be illustrated on several ambient intelligence scenarios, e.g., Fire Emergency and Home Automation. Thirdly, this demonstrator will integrate our recent and future scientific results in the domains of dynamic software product lines, autonomic computing, control loops, complex event processing, energy control, etc. Gwenael Cattez (newly graduated engineer) has been recruited in the context of this Inria ADT.

8.2. National Initiatives

8.2.1. ANR ARPEGE SALTY

Participants: Laurence Duchien, Philippe Merle, Russel Nzekwa, Romain Rouvoy, Lionel Seinturier.

SALTY is a 3-year ANR ARPEGE project started in November 2009 and involving University of Nice, Deveryware, EBM WebSourcing, INRIA ADAM, MAAT-G France, Thales, University Paris 8 and University Paris 6.
The main objective of the SALTY project is an autonomic computing framework for large-scale service-oriented architectures and infrastructures. The SALTY project will result in a coherent integration of models, tools and runtime systems to provide a first end-to-end support to the development of autonomic applications in the context of large-scale SOA in a model-driven way, including never-covered aspects such as the monitoring requirements, the analysis (or decision-making) model, and an adaptation model tackling large-scale underlying managed components. The project will be validated by two large use-cases: a neurodegenerative disease study for exploring the capacity of grid infrastructures and a path tracking application for exploiting the different positioning methods and appliances on a fleet of trucks.

8.2.2. ANR ARPEGE ITEmIS

Participants: Jonathan Labejof, Philippe Merle, Lionel Seinturier.

ITEmIS is a 30-month ANR ARPEGE project started in March 2009 and involving Thales, EBM WebSourcing, Inria (ADAM and ARLES), LAAS, ScalAgent, and IRIT.

The ITEmIS project aims at easing the evolution from today’s world of separate lightweight embedded applications and IT services to the future world of seamlessly integrated services, thus qualifying and defining a new generation SOA enabling IT and Embedded Integrated Systems (ITEmIS systems). This endeavour is undertaken along three main lines: (1) At business level, where IT/embedded services are integrated into advanced workflows supporting the multi-faceted interoperability and scalability required for ITEmIS systems; (2) At service infrastructure level, by introducing a specialized ESB-based and component-based solution addressing the requirements of the embedded world including deployment; and (3) Transversally for both above levels addressing end-to-end assurance of Quality of Service (QoS) and correctness verification of deployments and workflows at the level of their execution models. The PhD thesis of Jonathan Labejof is conducted in the context of this project.

Further information is available on the website of the project: http://itemis-anr.org/.

8.2.3. ANR ARPEGE SocEDA

Participants: Gabriel Hermosillo, Fawaiz Paraiso, Romain Rouvoy, Lionel Seinturier.

SocEDA is a 3-year ANR ARPEGE project started in November 2010 and involving EBM WebSourcing, ActiveEon, EMAC, I3S, LIG, LIRIS, INRIA ADAM, France Telecom and Thales Communications.

The goal of SocEDA is to develop and validate an elastic and reliable federated SOA architecture for dynamic and complex event-driven interaction in large highly distributed and heterogeneous service systems. Such architecture will enable exchange of contextual information between heterogeneous services, providing the possibilities to optimize/personalize their execution, according to social network information. The main outcome will be a platform for event-driven interaction between services, that scales at the Internet level based on the proposed architecture and that addresses Quality of Service (QoS) requirements.

Further information is available on the website of the project: http://www.soceda.org.

8.2.4. ANR CONTINT MOANO

Participants: Laurence Duchien, Anne-Françoise Le Meur, Nicolas Petitprez.

MOANO (Models & Tools for Pervasive Applications focusing on Territory Discovery) is a 36-month project of the ANR CONTINT program which has started in January 2011. The partners are LIUPPA/University of Pau and Pays de L’Adour, University of Toulouse/IRIT, University of Grenoble/LIG, University of Lille/LIFL/INRIA.

While going through a territory, mobile users often encounter problems with their handheld computers/mobiles. Some locally stored data become useless or unnecessary whereas other data is not included in the handheld computer. Some software components, part of the whole applications can become unnecessary to process some information or documents that the user did no plan to manage during his mission.
In order to answer such difficulties, our project has three operational studies which are i) to enlarge the communication scale, ii) to provide people without computer-science skills with a toolset that will enable them to produce/configure mapping applications to be hosted on their mobile phone and iii) to process all the documents of interest in order to make their spatial and thematic semantics available to mobile users.


8.2.5. Trade cluster MIND

Participants: Damien Fournier, Frédéric Loiret, Rémi Mélisson, Philippe Merle, Lionel Seinturier.

MIND is a 32-month project funded by the Minalogic cluster on micro- and nano-technologies. The project started in 2008. The partners of this project include: STMicroelectronics (Leader), CEA, France Telecom R&D, Grenoble 1, INERIS, INRIA, ICT, ISTIA, Itiris Automation Square, LOGICA, Schneider Electric, Sogeti High Tech, VERIMAG.

It aims at consolidating the component-based technologies and the tools, which exist around the FRACTAL component model for building middleware and systems. The goal is to transfer these results into an industrial strength software tool suite in order to foster the adoption of the component-based technologies for designing and developing embedded applications and systems.

8.2.6. Trade Cluster EconHome

Participants: Aurélien Bourdon, Rémi Druilhe, Laurence Duchien, Adel Noureddine, Romain Rouvoy, Lionel Seinturier.

EconHome is a 30-month project funded by FUI and labelized by the Minalogic and Systematic clusters. The project started in 2011. The partners of this project include: Sagemcom, Orange, STMicroelectronics, ST-Ericsson, SPIDCOM, Utrema, COMSIS, DOCEA, CEA, ETIS.

The project aims at reducing the energy consumption of home and middleware networks. The target is to reduce of at least 70% the energy consumption of devices such as residential gateways, set top boxes, CPL plugs. Two axes are investigated: the optimization of the energy consumption of individual devices with innovative low power and sleep modes, and the optimization of the overall network with innovative techniques such as service migration and energy aware service feedbacks to the user.

8.2.7. Trade Cluster MACCHIATO

Participants: Laurence Duchien, Anne-Françoise Le Meur, Nicolas Petitprez, Romain Rouvoy.

Macchiato is a 36-month project of the competitiveness cluster of trade industry of Nord/Pas-de-Calais PICOM (Pôle des Industries du COMmerce, see http://www.picom.fr), which has started in January 2011. The partners of this project are Auchan (leader), University of Bordeaux/LABRI, INRIA, Web Pulser (an SME).

The Macchiato project is to rethink the design of e-commerce sites to better integrate the Internet of Things and facilitate online sales. In addition to setting up an infrastructure and a common application base, this challenge needs to refocus the design of e-commerce sites on the concept of “single basket”. We believe that including the next generation of e-commerce sites will be able to offer a personalized offer to consumers by adapting the content and form of site to their preferences and needs and allowing them to manage its purchases uniformly by through a single basket [46].

See http://macchiato.lille.inria.fr/

8.2.8. Trade Cluster EasySOA

Participants: Michel Dirix, Philippe Merle, Christophe Munilla.

EasySOA is a 24-month project funded by FUI and labelized by the Systematic competitive cluster for Open Source (see at http://www.systematic-paris-region.org/). The project started in 2011. The partners of this project include: Open Wide (Leader), Bull, Easyfab, Inria, Nuxeo, Talend.
The EasySOA goal is to add an open, light, agile layer on top of « traditional » SOA, thanks to an online, social and collaborative approach, involving all actors of the SOA process. Beyond cartography and documentation, it helps gathering and fast-prototyping the business needs, and eases the transition to final implementations in the existing SOA solution.

Further information is available on the website of the project: http://www.easysoa.org.

8.2.9. GDR GPL Action: UbiLab

Participants: Nicolas Haderer, Romain Rouvoy, Lionel Seinturier.

The objective of UbiLab is to build an open software platform for federating scientific activities related to ubiquitous computing. In particular, UbiLab focuses on the definition of a remote sensing platform for collecting activity traces from mobile users using Android smartphones. This action is realized in collaboration with researchers from the CNRS LAAS research laboratory, who are currently working on geo-privacy concerns. In this context, the UbiLab action aims at defining common standards and procedures for collecting and exploiting such activity traces. At short-term, the results of UbiLab will leverage the research in the domains of geo-privacy and ubiquitous computing. At mid-term, we expect that the results of this action will allow other scientific communities to build specific experiments related to the study of mobile crowds behaviors.

8.2.10. INRIA ARC SERUS

Participants: Laurence Duchien, Alexandre Feugas, Anne-Françoise Le Meur, Lionel Seinturier.

SERUS (Software Engineering for Resilient Ubiquitous Systems) is founded by the INRIA collaboration program. The partners are INRIA ADAM Team, INRIA PHOENIX Team and TSF-LAAS (CNRS). Resilience is defined as the ability of a system to stay dependable when facing changes. For example, a building management system (e.g., anti-intrusion, fire detection) needs to evolve at runtime (e.g., deployment of new functions) because its critical nature excludes interrupting its operation. Resilience concerns occur in various application domains such as civil systems (civil protection, control of water or energy, etc.) or private systems (home automation, digital assistance, etc.).

The objectives of this project is to propose a design-driven development methodology for resilient systems that takes into account dependability concerns in the early stages and ensures the traceability of these requirements throughout the system life-cycle, even during runtime evolution. To provide a high level of support, this methodology will rely on a design paradigm dedicated to sense/compute/control applications. This design will be enriched with dependability requirements and used to provide support throughout the system life-cycle.

See http://serus.bordeaux.inria.fr/

8.3. European Initiatives

8.3.1. INRIA Associate Team SeaS: University of Oslo

Participants: Frédéric Loiret, Gabriel Hermosillo, Russel Nzekwa, Daniel Romero, Romain Rouvoy, Lionel Seinturier.

Middleware for Sensor as a Service (Seas) is a collaboration initiative that intends to contribute to the vision of the Future Internet as an open-source middleware platform, based on robust Web standards, breaking existing IT silos and leveraging the development of innovative hybrid service-oriented architectures spanning from Wireless Sensor Networks to Ubiquitous and Cloud Computing. Given that one of the objectives of Europe is to develop the convergence of IT networks (mobile or fixed) and the fact that many of the upcoming mobile devices are integrating services (from phones down to sensors and radio frequency identification), we believe that one of the challenges for the next generation society will consist in enabling a distributed middleware platform for the dynamic provision of hybrid services and the scalable dissemination of data. In particular, we believe that the sensor capabilities can be reflected as a service accessible from the Internet or any IT system using standard Web protocols. The resulting services will be hybrid in the sense that they will
reflect the wide diversity of sensor devices available nowadays, but we aim at providing a uniform solution to leverage the development of applications on top of physical or virtual sensors. This platform includes not only the sensor level (description, discovery, communication, reconfiguration...), but also the platform level services (dissemination, storage, query, adaptation...) that are required for enabling such a vision. The resulting platform will bring additional opportunities for the development of innovative service-based systems by exploiting the emergence of Wireless Sensor Networks (WSN), Ubiquitous Computing, and Cloud Computing environments. Along the three years of activity, the SeaS collaboration will target to incrementally achieve the following objectives:

- **TASK 1 on Integration**: Enabling Hybrid Service-Oriented Architectures,
- **TASK 2 on Adaptation**: Supporting Dynamic Evolution of Hybrid Sensor Services,
- **TASK 3 on Scalability**: Building a Scalable Data Dissemination Infrastructure.

Read more at [http://seas.ifi.uio.no/](http://seas.ifi.uio.no/).

### 8.3.2. ERCIM Working Group Software Evolution

**Participant**: Laurence Duchien.

The Working Group (WG) on Software Evolution is one of the many working groups supported by ERCIM. The main goal of the WG is to identify a set of formally-founded techniques and associated tools to support software developers with the common problems they encounter when evolving large and complex software systems. With this initiative, the WG plans to become a Virtual European Research and Training Centre on Software Evolution. Read more at [http://www.planet-evolution.org](http://www.planet-evolution.org).

### 8.3.3. IAP MoVES

**Participants**: Laurence Duchien, Patrick Heymans, Daniel Romero.

The Belgium IAP (Interuniversity Attraction Poles) MoVES (Fundamental Issues in Software Engineering: Modeling, Verification and Evolution of Software) is a project whose partners are the Belgium universities (VUB, KUL, UA, UCB, ULB, FUNDP, ULg, UMH) and three European institutes (INRIA, IC and TUD) respectively from France, Great Britain and Netherlands. The project has started in January 2007 and is scheduled for a 60-month period.

This consortium combines the leading Belgian research teams and their neighbors in software engineering, with recognized scientific excellence in MDE, software evolution, formal modeling and verification, and AOSD. The long term objective of our network is to strengthen existing collaborations and forge new links between those teams, and to leverage and disseminate our research expertise in this domain at an European level. The project focuses on the development, integration and extension of state-of-the-art languages, formalisms and techniques for modeling and verifying dependable software systems and supporting the evolution of Software-intensive systems.

This year, we welcome Patrick Heymans from FUNDP as invited scientist.

Read more at [http://moves.vub.ac.be](http://moves.vub.ac.be).

### 8.3.4. ICT FP7 SOA4All Integrated Project

**Participants**: Damien Fournier, Philippe Merle.

Service-Oriented Architectures for All (SOA4All) is a large-scale Integrating Project funded by the European Seventh Framework Program, under the Service and Software Architectures, Infrastructures and Engineering research area. This is a 36-month project started in March 2008. Partners are: Atos Origin (Spain), British Telecommunications (UK), CEFRIEL (Italy), EBM WebSourcing (France), Hanival Internet Services GmbH (Austria), INRIA (France), Intelligent Software Components (Spain), Ontotext Lab (Bulgaria), Open University (UK), SAP AG (Germany), Seekda OG (Austria), TIE (Netherlands), The University of Manchester (UK), TXT e-Solutions Spa (Italy), Universitaet Karlsruhe (Germany), University Innsbruck (Austria).
SOA4All will help to realize a world where billions of parties are exposing and consuming services via advanced Web technology: the main objective of the project is to provide a comprehensive framework and infrastructure that integrates complementary and evolutionary technical advances—i.e., SOA, context management, Web principles, Web 2.0 and Semantic Web—into a coherent and domain-independent service delivery platform [52].

Further information is available on the website of the project: http://www.soa4all.eu.

8.4. International Initiatives

8.4.1. OW2

Participants: Christophe Demarey, Damien Fournier, Philippe Merle, Romain Rouvoy, Lionel Seinturier.

OW2, previously ObjectWeb, is an international consortium to promote high quality open source middleware (see at http://www.ow2.org). The vision of OW2 is that of a set of components which can be assembled to offer high-quality middleware.

We are members of this consortium since a long time ago. Philippe Merle is the leader of both FRACTAL and FRASCATI projects, which are hosted by this consortium. Philippe Merle and Lionel Seinturier are members of the Technology Council of OW2.

8.4.2. University of Los Andes (Bogota)

Participants: Laurence Duchien, Gabriel Tamura.

The Ph.D. Student Gabriel Tamura is co-supervised by Rubby Casallas, University of Los Andes, and Laurence Duchien from University of Lille 1. The objective is to study a component-based architecture reconfiguration model and to address QoS (quality-of-service) contract preservation. The proposal is based on a formal theory to perform, in a safe way, the process of self-adaptation in response to quality-of-service (QoS) contracts violation. The results have been published in [36], [44]. The student has been in the ADAM project-team during six months this year. Laurence Duchien has visited the University of Los Andes in October 2009 and Rubby Casallas has visited the ADAM team in June 2010 and 2011.

8.5. Exterior research visitors

We have received four exterior research visitors in the year:

- Rubby Casallas, Associate Professor, University of Los Andes, Colombia, June 2011
- Norha Villegas, Ph.D Student, University of Victoria, Canada, April 2011
- Nadia Gamez, Ph.D. Student, University of Malaga, Spain, Sept-Dec 2011
- Patrick Heymans, Professor, University of Namur, Belgium, Sept-Dec 2011
8. Partnerships and Cooperations

8.1. Regional initiatives

Participants: Sylvain Contassot-Vivier, Lucas Nussbaum, Martin Quinson.

8.1.1. CPER MISN, EDGE project

Martin Quinson and Lucas Nussbaum are leading a project of the regional CPER contract, called *Expéri- mentations et calculs distribués à grande échelle* (EDGE). A cluster targeting large-scale experiments (144 single-CPU nodes) was bought in 2010 in that context. In 2011, we focused on maintaining and improving the local Grid’5000 infrastructure, and animating both the research on experimental grids and the research community using these facilities. More information is available at [http://misn.loria.fr/spip.php?rubrique8](http://misn.loria.fr/spip.php?rubrique8).

8.1.2. Other regional grants

Martin Quinson received a grant from the Lorraine Region for two years (2010–2011) to fund our exploratory work on the possibility to use formal methods such as model-checking to ensure some properties (such as the lack of deadlocks in any case) of large-scale distributed algorithms. The results of this action are described in Section 6.2.2.

Sylvain Contassot-Vivier received a grant from the Lorraine Region for two years (2011–2013) to support a research project over dynamical systems: *Dynamical systems: theoretical study and application to parallel algorithmic for PDEs solving*.

8.2. National Initiatives

Participants: Sébastien Badia, Sylvain Contassot-Vivier, Stéphane Genaud, Jens Gustedt, Emmanuel Jeanvoine, Lucas Nussbaum, Martin Quinson, Tinaherinantenaina Rakotoarivelo, Luc Sarzyniec, Stéphane Vialle.

8.2.1. INRIA ADT SimGrid for human beings (2009–2011)

*SimGrid for human beings* is another INRIA Technological Development Action aiming at providing engineering manpower to the SimGrid project to improve the documentation and to provide stock implementations of classical algorithms in order to ease its usage by the users. Mehdi Fekari was hired on this project, leading to the results described in Section 6.2.1.

8.2.2. INRIA ADT Aladdin-G5K (2007–2012?)

ADT Aladdin-G5K (A LArge-scale Distributed Deployable INfrastructure) is an INRIA Technological Development Action. It is a management structure for Grid’5000. The goal of Aladdin-G5K is to further develop the Grid’5000 testbed, and perform system administration and maintenance, as well as additional tasks such as maintaining the various tutorials. Three engineers from Nancy (two from AlGorille, one from SED) are contributing to Aladdin-G5K: Tina Rakotoarivelo (hired for the ADT), Sébastien Badia (IE CPER) and Benjamin Dexheimer (SED).

8.2.3. INRIA ADT Kadeploy (2011–2013)

ADT Kadeploy focuses on the Kadeploy software. Kadeploy is a tool for efficient, scalable and reliable cluster deployment, used on several clusters at INRIA and playing a key role on the Grid’5000 testbed. This ADT allows us to continue the development of Kadeploy, by improving its performance, its reliability and its security. We are also adding features that are required in some contexts so that it will be possible to further distribute Kadeploy and increase its usage. During the ADT, we are collaborating with INRIA platforms that do not use Kadeploy yet, but have similar needs, as well as with industry. Luc Sarzyniec was hired as young engineer (IJD) as part of this project.
8.2.4. INRIA ADT Solfege (2011–2013)

ADT Solfege (Services et Outils Logiciels Facilitant l’Experimentation à Grande Échelle) aims at developing or improving a tool suite for experimentation at large scale on testbeds such as Grid’5000. Specifically, we will work on control of a large number of nodes, on data management, and on changing experimental conditions with emulation. Emmanuel Jeanvoine (SED) is delegated in the AlGorille team for the duration of this project.

8.2.5. INRIA AEN HEMERA

Héméra is an INRIA Large Wingspan project, started in 2010, that aims at demonstrating ambitious up-scaling techniques for large scale distributed computing by carrying out several dimensioning experiments on the Grid’5000 infrastructure, at animating the scientific community around Grid’5000 and at enlarging the Grid’5000 community by helping newcomers to make use of Grid’5000. Within that project, Martin Quinson, Lucas Nussbaum and Stéphane Genaud lead three working groups, respectively on simulating large-scale facilities, on conducting large and complex experimentations on real platforms, and on designing scientific applications for scalability.

8.2.6. CNRS initiatives, GDR-ASR and specific initiatives

We participate at numerous national initiatives. In the GDR-ASR (architecture, systems, and networks) we take part in RGE action \(^1\). The finances of RGE, led by Stéphane Vialle at SUPÉLEC, are provided by the GDR ASR of CNRS and maintained by AlGorille. The RGE action organizes three meetings per year, and usually gathers 40-45 people per meeting.

Sylvain Contassot-Vivier decided to stop his animation role in the Embedded Pole in 2011 in order to focus on his research activities. However, he continues his expert analysis for the MEI (Mission d’Expertises Internationales).

8.2.7. ANR USS-SimGrid (2009–2011) and ANR SONGS (2011–2015)

Martin Quinson is the principal investigator of one project of the ARPEGE call from the ANR (french funding agency), called USS-SimGrid (Ultra Scalable Simulation with SimGrid – 2009–2011). It aims at improving the scalability of the SimGrid simulator to allow its use in Peer-to-Peer research in addition of Grid Computing research. The challenges to tackle include models being more scalable at the eventual price of slightly reduced accuracy, automatic instantiation of these models, tools to conduct experiments campaigns, as well as a partial parallelization of the simulator tool.

Martin Quinson is also the principal investigator of a project of the INFRA call from the ANR, called SONGS (Simulation Of Next Generation Systems – 2012-2016). It aims at increasing the target community of SimGrid to two new research domains, namely Clouds (restricted to the Infrastructure as a Service context) and High Performance Computing. We will develop new models and interfaces to enable the use of SimGrid for generic and specialized researches in these domains.

As project leading team, we are involved in most parts of these projects, which allows the improvement of our tool even further and set it as the reference in its domain (see Sections 6.2.1 through 6.2.5).

8.2.8. Bilateral Collaborations

With Arnaud Giersch from the University of Franche-Comté, we work on the design and implementation of a decentralized load-balancing algorithm, based on asynchronous diffusion, that works with dynamical networks. In such a context, we consider that the nodes are always available but the links between them may be intermittent. According to the load-balancing task, this is a rather difficult context of use.

Lucas Nussbaum and Martin Quinson are participating to a research effort lead by F. Suter from the Computing Center of IN2P3. This project is jointly funded by CNRS’ Institut des Grilles and INRIA’s ADT Aladdin in a program that aims at bridging the production grids and distributed systems research communities. The overall goal of the project is to explore ways to enable the scientific study and the evaluation of improvements in the context of the gLite grid middleware. New results in this project are described in Section 6.2.7.

\(^1\) Réseau Grand Est
8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

8.3.1.1. Energy efficiency in large scale distributed systems.

Stéphane Vialle, Sylvain Contassot-Vivier and Thomas Jost participate to the COST (European Cooperation in the field of Scientific and Technical Research) Action IC0804 (Energy efficiency in large scale distributed systems), started in 2010.

Our designs of PDE solvers using synchronous and asynchronous distributed algorithms, implemented and experimented both on CPU and GPU clusters, have led to the design of some performance models. Main results have been introduced in 2011 in a book chapter [26].

Moreover, in 2011 we achieved a first design of a software architecture to build self-configurating applications, in order to track a user instruction (to run fast, or to run consuming low energy, or to run achieving a compromise) in an execution environment imposing some energy constraints on application runs. This software architecture has been introduced to the COST IC0804 meeting of May 19-20, 2011 in Budapest. This software architecture is still under investigation, and its implementation is planned for 2012.

Finally, in 2011 we have achieved the implementation of an American option pricer on our GPU clusters, and we have run many experiments to measure its speedup and energy gain. A second version, more efficient, including an optimized 4D to 2D reduction on each GPU node, is under experimentation at the end of 2011. These research are conducted in collaboration with some colleagues of University of Marne-la-Vallée.

8.4. International Initiatives

8.4.1. Bilateral Collaborations

This year, we formalized the collaboration on the modeling of storage elements that we had with the team PH-ADP-DDM lead by V. Garone at CERN and with F. Suter from the Computing Center of IN2P3. This work will now be done in the context of the SONGS project, that got funded by the ANR this year.

We also started working with IBM France and IBM Haifa on the modeling of Cloud jobs and resources, also in the loose context of the SONGS project. This collaboration should take some more momentum in the next few years.

Finally, we are working with the team of Jan Broeckhove (Professor at university of Antwerp, Belgium), in a project funded (2010-2011) by the PHC Tournesol program. This project aims at exploring Large-Scale Discrete-Event Simulation of Distributed Systems.

We collaborate with Henri Casanova of University of Hawai’i at Manoa on the SimGrid framework, as detailed in 5.4. The result obtained this year on the simulation of MPI applications are detailed in Section 6.2.4.

We also collaborate with David Elizondo from the University of Leicester in Great Britain on the problem of linear separability determination. Our current work deals with the design and implementation of a fast algorithm to determine whether or not two or more sets of points in \( \mathbb{R}^n \) are linearly separable. We have already obtained an interesting result in 2D whose publication is in preparation. The next step is the extension to \( n > 2 \) dimensions.

8.4.2. INRIA International Partners

8.4.2.1. Internships

Matías Ezequiel Vara

Subject: Ordered Read-Write Locks on Multicore Architectures

Institution: Universidad Nacional de La Plata (Argentina)
8. Partnerships and Cooperations

8.1. Local Initiatives

8.1.1. BQR - Design Methods for Energetic Optimisation in Wireless Sensor Networks

Participants: Nicolas Stouls [Project leader], Antoine Fraboulet, Lionel Morel, Guillaume Salagnac.

Glossary

BQR (Bonus Qualité Recherche) project funded by an academic institution.

This project, funded by INSA Lyon, is a collaboration between three research laboratories: CITI (Center of Innovation in Telecommunications and Integration of services), LIRIS (Computer Science, Image and Information Systems Laboratory) and CETHIL (Lyon Thermal Center). The project aims at proposing a practical instrumentation technique for measuring energetic efficiency of buildings by means of using a wireless network of sensor nodes (WSN). In order to make it feasible to scale both space-wise (instrumenting a while building will require tens or hundreds of nodes) as well as duration-wise (the experiments we envision in this project will span over several months), we adopt a software architecture based on a dedicated streaming database technology [39]. Finally, this whole system is also a case-study for another goal of this project, that of proposing new metrics to characterize energy consumption on embedded devices (in particular we aim at somehow relating energy consumption to a high-level view of the software running on the nodes).

8.1.2. BQF - Smart Chappe Building: A Context-aware Service Platform

Participants: Frédéric Le Mouël [Project leader], Julien Ponge, Stéphane Frénot.

Glossary

BQF (Bonus Qualité Formation) project funded by an academic institution.

This project, funded by INSA Lyon, is leaded by the Telecommunication Department with the participation of two research laboratories: CITI (Center of Innovation in Telecommunications and Integration of services) and LIRIS (Computer Science, Image and Information Systems Laboratory).

Computers and Information Systems are now all around us (Ubiquitous Computing) with a great number of portable and mobile devices (Mobile Computing) that have to adapt to highly changing environments (Context-aware Computing) and that even disapear in our every life in small, active and smart objects (Ambient Intelligence). Smart Houses and Buildings is now an emerging research topic with power managing, security monitoring, .... We think that mobile phones will be the universal remote controller for a user-personalized access to services of such buildings.

Build in 2008, the Claude Chappe Building - hosting the Telecommunication Department and the CITI Lab - is the perfect experimentation place. The Smart Chappe Building proposes a Context-aware Service Platform integrating (i) devices: static ones (large display screens, interactive terminal), mobile phones (iPhone with iOS, Samsung with Android, HTC with Windows Mobile), sensors (temperature, hydrometry), RFID, (ii) wireless connectivity: Bluetooth, WIFI and (iii) context-aware and user-personalized services: building guidance, news broadcasting, lecture agenda. This plateform is bothly used for teaching and doing research, for instance, by allowing to develop and integrate new innovative services.

8.1.3. INRIA ADT ORSI

Participants: Antoine Fraboulet [Project leader], Julien Carpentier.

ORSI (Outil de Raffinement de la Simulation à l’Implantation) is an INRIA ADT project started in November 2010.
The ORSI ADT is in the context of programming tools for constrained embedded systems applications. This ADT is the continuation and extension of techniques and tools developed in the scope of wireless sensor networks. Projects like RECAP, SensLab, WASP, and Mosar have demonstrated the value and contribution of WSIM and WSNet software simulation tools which are now used outside of their original projects’ frames. Dissemination and software use in academic and industrial projects can consider their evolution in order to take into account new types of uses and new development paths. The ORSI ADT aims to extend the models used in these software to prepare them for next generation applications, hardware, and software targets.

8.2. Regional Initiatives

8.2.1. SEmba - Embedded Systems

Participants: Nicolas Stouls (Co-leader), Stéphane Frénot, Antoine Fraboulet, Lionel Morel, Guillaume Salagnac, Yufang Dan.

SEmba, standing for Embedded Systems (“Systèmes Embarqués” in French), is a project funded by the ISLE cluster of the Rhône-Alpe department. This project aims at animating and structuring regional research activities, in order to give more visibility of our results, and at promoting collaborations between academic and industrial teams of the regions. Current academic labs of the project are:

- TIMA, GIPSA-Lab, INRIA Grenoble, LIG, VERIMAG (Grenoble),
- CITI, INL, LIP (Lyon),
- LHC (Saint-Etienne),
- LAMA (Savoie),
- LCIS (Valence).

To produce enhanced embedded systems is a non-stopping effort, due to constant technologies evolutions in nano and micro-electronic. Locks lie in the low cost, low electrical consumption, fast conception and development processes and the quality of systems, as well for the hardware as for the software parts. Project is managed by Dominique Borrione (TIMA Lab) and Nicolas Stouls (CITI Lab), and is organized with three themes:

1. Architectures and conception (software/hardware, components, synthesis)
2. Evaluation of embedded systems quality (validation, test, reliability, performance, quality of service)
3. Communicating infrastructures (protocols, OS, middleware, sensors networks, security, networks on chip)

8.3. National Initiatives

8.3.1. UbiqueSt

ANR UbiqueSt, Ubiquitous Quest: declarative approach for integrated network and data management in wireless multi-hop networks, with Grenoble Institute of Technology (Christine Collet, Christophe Bobineau), 2009-2012

8.3.2. ANR LISE

Participant: Stéphane Frénot.

Software quality and patterns of security frauds are directly related to legal liability patterns but, so far, software providers have succeeded in limiting their legal liability for their products. The increasing dependence of society on software changes the situation however, and calls for stronger liability rules.
The precise definition of the expected functionalities of software products is quite a challenge, not to mention the use of such definition as a basis for a liability agreement. Taking up this challenge is precisely the objective of the LISE project. To achieve this goal, software liability is addressed both from the legal and the technical points of view with the aim to put forward methods (1) to define liability in a precise and legally sound way and (2) to establish liability in case of incident. http://licit.inrialpes.fr/lise/

8.3.3. ANR TLCOM Senslab

**Participant:** Antoine Fraboulet.

The purpose of the SensLAB project is to deploy a very large scale open wireless sensor network platform. SensLAB’s main and most important goal is to offer an accurate and efficient scientific tool to help in the design, development, tuning, and experimentation of real large-scale sensor network applications. Amazones contributes to the Senslab project through the participation of Antoine Fraboulet who was involved in the early project design phases and through the use of the software simulation suite WSNet, WSim and eSimu in the Senslab project.

8.3.4. ADT SensTools

**Participant:** Antoine Fraboulet.

SensTools is a national INRIA ADT. The project ended in 2010, the final review was held in Lyon on December, 15th. SensTools provides a set of hardware and software tools for the WSN430 platform. Some basic drivers and several OSes are provided.

8.3.5. ADT SensAS

**Participants:** Antoine Fraboulet, Guillaume Salagnac.

SensAS is an INRIA national ADT project started in December 2010. The SENSAS project’s ambition is to support the development of innovative applications from INRIA EPIS involving several networks of sensors / actuators and / or fleets of robots. From the strong experience in sensor networks, the idea is to build and pool equipment and software in order to have a leverage at the application level. The target applications are selected monitoring / intrusion detection by a fleet robot, self organizing fleets of drones flying biologging applications in the field of health and supervision of large networks of sensors. The SENSAS ADT will amplify skills transfer and facilitate access to implementation of sensor networks technology. In deploying demonstrators at the forefront of technology, the SENSAS ADT showcases the technological expertise and scientific excellence of INRIA who established his reputation in this field.

Amazones is leader of the WP4: SensBOX : software suite for sensor and actuator networks.

8.4. European Initiatives

8.4.1. EU Project Wasp (FP6 IP project)

**Participant:** Antoine Fraboulet.

The WASP project (Wirelessly Accessible Sensor Populations, European Project IST-034963) ended in November 2010. The final review took place in London on October, 21th and 22th 2010. The general goal of the project was the provision of a complete system view for building large populations of collaborating objects. The system incorporates networking protocols for wireless sensor nodes to hide the individual nodes from the application.

Amazones was involved in the project through the participation of Antoine Fraboulet. Antoine Fraboulet was responsible for several deliverables for precompilation tools and software support. He was also member of the project’s architecture team.

8.4.2. EU Project Mosar (LSH European Project)

**Participant:** Antoine Fraboulet.
The goal of the MOSAR project is to study the dynamics of neighborhood people using networks of sensors in a hospital. Amazones was involved in MOSAR through the participation of Antoine Fraboulet. Involvement: implementation of hardware and software support for the project, large scale deployment of a full wireless sensor network and study of dynamic graph patterns.
The CONNECT Integrated Project aims at enabling continuous composition of networked systems to respond to the evolution of functionalities provided to and required from the networked environment. At present the efficacy of integrating and composing networked systems depends on the level of interoperability of the systems’s underlying technologies. However, interoperable middleware cannot cover the ever growing heterogeneity dimensions of the networked environment. CONNECT aims at dropping the interoperability barrier by adopting a revolutionary approach to the seamless networking of digital systems, that is, synthesizing on the fly the connectors via which networked systems communicate. The resulting emergent connectors are effectively synthesized according to the behavioral semantics of application- down to middleware-layer protocols run by the interacting parties. The synthesis process is based on a formal foundation for connectors, which allows learning, reasoning about and adapting the interaction behavior of networked systems at run-time. Synthesized connectors are concrete emergent system entities that are dependable, unobtrusive, and evolvable, while not compromising the quality of software applications. To reach these objectives the CONNECT project undertakes interdisciplinary research in the areas of behavior learning, formal methods, semantic services, software engineering, dependability, and middleware. Specifically, CONNECT investigates the following issues and related challenges: (i) Modeling and reasoning about peer system functionalities, (ii) Modeling and reasoning about connector behaviors, (iii) Runtime synthesis of connectors, (iv) Learning connector behaviors, (v) Dependability assurance, and (vi) System architecture. The effectiveness of CONNECT research is assessed by experimenting in the field of wide area, highly heterogeneous systems where today’s solutions to interoperability already fall short (e.g., systems of systems).

7.1.2. FP7 ICT IP CHOREOS

Participants: Sandrine Beauche, Nebil Ben Mabrouk, Benjamin Billet, Nikolaos Georgantas, Sara Hachem, Valérie Issarny, Animesh Pathak, Roberto Speicys Cardoso.

- **Name:** CHOREOS – Large Scale Choreographies for the Future Internet
- **URL:** http://www.choreos.eu/
- **Related activities:** § 6.3
- **Period:** [February October 2010 - September 2013]
- **Partners:** BPI (Lithuania), CEFRIEL (Italy), CNR (Italy), eBM WebSourcing S.A.S (France), Inria (CRI Paris-Rocquencourt) [scientific leader], MLS Multimedia A.E. (Greece), OW2 Consortium, Thales Communications S.A. (France) [coordinator], The City University, London (UK), Università degli Studi dell’Aquila (Italy), Universidade de São Paulo (Brazil), University of Ioannina (Greece), SSII VIA (Latvia), Virtual Trip Ltd. (Greece), Wind Telecommunicazioni S.p.A (Italy).
CHOReOS aims at assisting the engineering of software service compositions in the revolutionary networking environment created by the Future Internet. Indeed, sustaining service composition and moving it closer to the end users in the Future Internet is a prime requirement to ensure that the wealth of networked services will get appropriately leveraged and reused. This again stresses the required move from static to dynamic development, effectively calling for adequate support for service reuse; much like software reuse has been a central concern in software engineering over the last two decades. This is why CHOReOS adopts the Service Oriented Computing (SOC) paradigm, where networked resources are abstracted as services so as to ease their discovery, access and composition, and thus reuse. However, although latest advances in the SOC domain enable facing (at least partly) the requirements of today’s Internet and related networking capabilities, engineering service compositions in the light of the Future Internet challenges — in particular the ultra large scale (ULS) on all imaginable dimensions as well as the evolution of the development process from a mostly static process to a dynamic user-centric one — is far from adequately addressed. Therefore, the CHOReOS goal is to address these challenges by devising a dynamic development process, and associated methods, tools and middleware, to sustain the composition of services in the Future Internet.

7.1.3. FP7 PEOPLE Requirements@run.time
Participants: Nelly Bencomo, Valérie Issarny.
- Name: Requirements@run.time: Requirements-aware systems
- URL: https://www-roc.inria.fr/arles/index.php/members/220-marie-curie-project-requirements-aware-systems-requirementsruntime
- Related activities: § 6.2
- Period: [May 2011 - May 2013]
- Partners: Inria (CRI Paris-Rocquencourt).

This project uses the novel notion of requirements reflection, that is, the ability of a system to dynamically observe and reason about its requirements. It aims to address the need of having systems requirements-aware by reifying requirements as run-time objects (i.e. requirements@run.time). These systems provide a runtime model of their requirements that allow them to reason, evaluate and report on their conformance to their requirements during execution. This project contributes towards development of conceptual foundations, engineering techniques, and computing infrastructure for the systematic development of dynamically-adaptive systems based on the principle of requirements reflection. The researchers build upon their extensive expertise in the area of reflective middleware and reflective architectures and research projects like CONNECT.

7.1.4. FP7 ICT NoE NESSoS
Participants: Valérie Issarny, Animesh Pathak, Rachid Saadi, Amir Seyedi.
- Name: NESSoS – Network of Excellence on Engineering Secure Future Internet Software Services and Systems
- URL: http://www.nessos-project.eu
- Related activities: § 6
- Period: [October 2010 - March 2013]
- Partners: Atos Origin (Spain), CNR (Italy) [coordinators], ETH Zürich (Switzerland), IMDEA Software (Spain), Inria (EPI ARLES, CASSIS, and TRISKELL), KU Leuven (Belgium), LMU München (Germany), Siemens AG (Germany), SINTEF (Norway), University Duisburg-Essen (Germany), Universidad de Malaga (Spain), Università degli studi di Trento (Italy).
The Network of Excellence on Engineering Secure Future Internet Software Services and Systems (NESSoS) aims at constituting and integrating a long lasting research community on engineering secure software-based services and systems. The NESSoS engineering of secure software services is based on the principle of addressing security concerns from the very beginning in system analysis and design, thus contributing to reduce the amount of system and service vulnerabilities and enabling the systematic treatment of security needs through the engineering process. In light of the unique security requirements exposed by the Future Internet, new results are achieved by means of an integrated research, as to improve the necessary assurance level and to address risk and cost during the software development cycle in order to prioritize and manage investments. NESSoS integrates the research labs involved; NESSoS re-addresses, integrates, harmonizes and fosters the research activities in the necessary areas, and increases and spreads the research excellence. NESSoS also impacts training and education activities in Europe to grow a new generation of skilled researchers and practitioners in the area. NESSoS collaborates with industrial stakeholders to improve the industry best practices and support a rapid growth of software-based service systems in the Future Internet.

7.1.5. FP7 ICT CA EternalS
Participants: Amel Bennaceur, Valérie Issarny, Animesh Pathak, Daniel Sykes.
- Name: EternalS – Trustworthy Eternal Systems via Evolving Software, Data and Knowledge
- URL: [http://www.eternals.eu](http://www.eternals.eu)
- Related activities: § 6.2
- Period: [March 2010 - February 2013]
- Partners: Inria (CRI Paris-Rocquencourt), KU Leuven (Belgium), Queen Mary University (UK), University of Chalmers (Sweden), University of Trento (Italy), Waterford Institute of Technology (Ireland).

Latest research work within ICT has allowed to pinpoint the most important and urgently required features that future systems should possess to meet users’ needs. Accordingly, methods making systems capable of adapting to changes in user requirements and application domains have been pointed out as key research areas. Adaptation and evolution depend on several dimensions, e.g., time, location, and security conditions, expressing the diversity of the context in which systems operate. A design based on an effective management of these dimensions constitutes a remarkable step toward the realization of Trustworthy Eternal Systems. The EternalS Coordination Action specifically aims at coordinating research in that area based on a researcher Task Force together with community building activities, where the organization of large workshops and conferences is just one of the tools that will be used to conduct a successful CA.

7.1.6. PHC Ulysses: Middleware for Mobile Social Applications in Smart Urban Environments
Participant: Animesh Pathak.
- Name: Middleware for Mobile Social Applications in Smart Urban Environments
- Related activities: § 6.6
- Period: [Jan 2011 - December 2011]
- Partners: Inria (CRI Paris-Rocquencourt), Trinity College, Dublin, Ireland.

This project aims at investigating how the exploitation of novel information and communication technologies (ICT) in the field of mobile social networking can improve the quality of life of citizens. In particular, it investigates how novel shared urban infrastructures, such as bike sharing schemes, can become neighborhood hubs and offer community services to users. For example as users collect a bike, the application that they have installed on their smart phone synchronizes with the infrastructure installed on the bike sharing station, automatically retrieving information relevant to their interests and publishing any prepared postings. Users can read information or prepare postings at their leisure. The main research questions that need to be addressed to fulfill this vision include: (i) the design of appropriate data representation, management and exchange models, to support different types of data (local vs. global, short-lived vs. long-lived), to deal
with distributed/inconsistent knowledge, as well as with data provenance and authentication; (ii) the seamless integration of different computing platforms and architectures (e.g., user devices, city infrastructure); (iii) the need for adequate privacy and security support to protect personal social data; and (iv) the need to design applications that are able to deal with the scale of urban environments. The project relies on the Yarta middleware (§ 5.6), which includes a flexible and expressive representational framework for social data, tools to develop application-specific data models, and a set of middleware components to manage social information in mobile environments.

7.2. International Research Networks and Work Groups

7.2.1. ForeverSOA Associated Team

- **Name:** ForeverSOA – A rigorous approach to the evolution of service-oriented software
- **URL:** http://dmod.cs.uoi.gr/ForeverSOA/index.htm
- **Related activities:** § 6.3
- **Period:** [2009 - 2011]
- **Participants:** Joint team with University of Ioannina (UoI), Department of Computer Science, Greece.

This objective of the team is to study a principled approach for the dynamic maintenance of service-oriented software (i.e., software that is built by composing available services) on the basis of fundamental design principles and middleware that supports their adoption. The need for maintaining service-oriented software may be triggered by changes in the quality requirements of the end-users of service-oriented software (e.g., performance, availability, reliability), or by the the independent evolution of constituent services (e.g., services may be deployed or undeployed at anytime).

7.2.2. ERCIM WG SERENE

- **Name:** ERCIM Working Group – Software EngineRing for rEsilieNt systEms
- **URL:** http://serene.uni.lu/tiki/tiki-index.php
- **Period:** [Created 2004]
- **Participants:** Aabo Akademi (Finland), BUTE (Hungary), CNR (Italy), CWI (The Netherlands), FNR (Luxembourg), FORTH (Greece), Fraunhofer FOKUS & IPSI (Germany), Inria (CRI Paris-Rocquencourt), LAAS-CNRS (France), National Aerospace University (Ukraine), Nokia Research (Finland), NTNU (Norway), Oak Ridge National Laboratory (USA), Polit. di Milano (Italy), Poznan University of Technology (Poland), SARIT (Switzerland), SpaRCIM (Spain), SZTAKI (Hungary), University of L’Aquila (Italy), University Mc Gill (Canada), University Mc Master (Canada), University of Florence (Italy), University of Ioannina (Greece), University of Groningen (The Netherlands), University of Newcastle (UK), University Roma Tor Vergata (Italy), University of Southern Denmark in Odense (Denmark), VTT (Finland).

SERENE considers resilient systems as open and distributed systems that can dynamically adapt in a predictable way to unexpected events. Engineering such systems is a challenging issue still not solved. Achieving this objective is a very complex task since it implies reasoning explicitly and in a combined way, on system’s functional and non-functional characteristics.

SERENE advocates that resilience should be explicitly included into traditional software engineering theories and practices and should become an integral part of all steps of software development. As current software engineering practices tend to capture only normal behavior, assuming that all abnormal situations can be removed during development, new software engineering methods and tools need to be developed to support explicit handling of abnormal situations. Moreover, every phase in the software development process needs to be enriched with phase specific resilience means.
7.2.3. ERCIM WG STM

- **Name:** ERCIM Working Group – Security and Trust Management
- **URL:** [http://www.iit.cnr.it/STM-WG/](http://www.iit.cnr.it/STM-WG/)
- **Period:** [Created 2005]
- **Participants:** AARIT Research (Austria), ATOS Research (Spain), British Telecom, CNR (Italy), CETIC (Belgium), CWI (The Netherlands), DTU (Denmark), FORTH-ICS (Greece), FNR (Luxembourg), FNRS (Belgium), Fraunhofer SIT (Germany), HP Labs (UK), IBM Research, Ie Business School (Spain), Inria (CRI Paris-Rocquencourt & Sophia Antipolis), IUC (Ireland), L3S (Germany), Marasky University (Czech Republic), Microsoft EMIC (Germany), NTNU (Norway), Politecnico Torino (Italy), SAP (Germany), SARIT (Switzerland), SICS (Sweden), Siemens Corporate Technology, SparCIM (Spain), SZTAKI (Hungary), TUBITAK UEKAE (Turkey), VTT (Finland), University of East London (UK), University of Luxembourg (Luxembourg), University of Milan (Italy), University of Portsmouth (UK), University of Roma Tor Vergata (Italy), University of Trento (Italy), University of Twente (The Netherlands), VCPC (Austria), VTT (Finland), W3C.

The pervasive nature of the emerging Information and Communication Technologies (ICT) expands the well known current security problems on ICT, due to the increased possibilities of exploiting existing vulnerabilities and creating new threats. On the other hand, it poses new problems in terms of possible attack scenarios, threats, menaces and damages. Moreover, the increased virtual and physical mobility of the users enhances their interaction possibilities. Thus, there is a demand for a reliable establishment of trust relationships among the users. Privacy is also a main concern in the current ambient intelligence paradigm: everywhere there are devices interacting with users and information about the users is possibly being gathered by the devices at anytime. All these problems are perceived at different levels of concern by users, technology producers, scientific and governance communities.

This ERCIM Working Group aims at focusing the research of the ERCIM institutions on a series of activities (e.g., projects and workshops) for fostering the European research and development on security, trust and privacy in ICT. These will be among the main issues of current and future research efforts for “security” in a broad sense in Europe ([http://www.cordis.lu/security/](http://www.cordis.lu/security/)).

7.3. National Contacts and Grants

7.3.1. ANR ITEmIS: IT and Embedded Integrated Systems

- **Participants:** Mohammad Ashiqur Rahaman, Sandrine Beauche, Amir Seyedi, Nikolaos Georgantas.
- **Name:** ITEmIS – IT and Embedded Integrated Systems
- **Related activities:** § 6.3
- **Period:** [January 2009 – December 2011]
- **Partners:** Thales Communications S.A, EBM Websourcing, Inria ARLES, Inria ADAM, LAAS - CNRS, ScalAgent, IRIT.

Service-Oriented Architecture (SOA), as a key architectural pattern for prompt and rapid integration, is today a cornerstone of the agile Information Technology (IT) wave. Indeed, most of today’s greatest successes, in terms of bringing agility to the whole enterprise through its IT backbone, have been provided by SOA and its major technological counterparts that are the Web Services and the Enterprise Service Bus (ESB). At the same time, large control and command systems are envisaged, which may roughly be described as net-centric assemblies of heterogeneous lightweight sensors and actuators along with several large control systems. To accomplish such systems, there is currently a strong need of techniques at the cutting edge of technology that could bring seamless integration and deployment of lightweight embedded applications and IT services in a global agile system of services. In this context, ITEmIS aims at easing the evolution from today’s world of separate lightweight embedded applications and IT services to the future world of seamlessly integrated services, thus qualifying and defining a new generation SOA enabling IT and Embedded Integrated Systems (ITEmIS systems).
7.3.2. **ANR MURPHY: Dependability-focused Evaluation of Sensor Networks**

**Participant:** Animesh Pathak.

- **Name:** MURPHY – Dependability-focused Evaluation of Sensor Networks
- **Related activities:** § 6.5
- **Period:** [January 2011 – December 2013]
- **Partners:** CNAM, Inria ARLES, LAAS - CNRS, SmartGrains, Univ. Valenciennes.

Murphy aims at easing the development of dependable and pervasive applications built on top of robust wireless sensor networks, thus providing a mean for early detection of possible failures, by estimating dependability metrics. This endeavor is undertaken by providing:

- Fault detection based on in-network event processing,
- Fault injection which attempts to accelerate the occurrence of faults so as to judge the quality of the error handling and hence, facilitate the evaluation of dependability,
- Advanced code dissemination across sensor networks, which is intended to (i) enable the dynamic and distributed insertion of faults and (ii) hide from the end user the complexity related to this task,
- Suitable abstractions to reason on faults, wireless sensor networks, data-centric and event-driven applications.

The aforementioned components enable to detect faults, diagnose possible causes and select appropriate corrective actions, and therefore to consolidate the dependability of sensor applications.

7.3.3. **Inria D2T Action de Developpement Technologique Srijan**

**Participants:** Animesh Pathak, Iraklis Leontiadis.

- **Name:** Srijan – Data-driven Macroprogramming for Heterogeneous Sensor
- **Related activities:** § 6.5, § 5.5
- **Period:** [October 2009 – September 2011]
- **Partners:** Inria (CRI Paris-Rocquencourt, EPI ARLES)

Macroprogramming is an application development technique for wireless sensor networks (WSNs) where the developer specifies the behavior of the system, as opposed to that of the constituent nodes. In this research, we are working on Srijan, a toolkit that enables application development for WSNs in a graphical manner using data-driven macroprogramming, including specification of application as a task graph, customization of the auto-generated source files with domain-specific imperative code, specification of the target system structure, and compilation and deployment of the macroprogram into individual customized runtimes for each constituent node of the target system.

7.3.4. **Inria D2T Action de Developpement Technologique MobiTools**

**Participants:** Valérie Issarny, Bachir Moussa Tari Bako.

- **Name:** MobiTools – Environnement de développement logiciel pour plateforme mobiles
- **Related activities:** § 5
- **Period:** [January 2011 – December 2012]
- **Partners:** Inria (CRI Paris-Rocquencourt, EPI ARLES)

As part of the development of our software prototypes, MobiTools focuses on setting a supporting continuous integration platform (compilation, test, profiling, quality).
7.3.5. Inria DTI Action de Transfert iBICOOP

**Participants:** Valérie Issarny, Roberto Speicys Cardoso.

- **Name:** iBICOOP – *Middleware for mobile collaborative applications*
- **Related activities:** § 5.7
- **Period:** [November 2009 - April 2011]
- **Partners:** Inria (CRI Paris-Rocquencourt, EPI ARLES)

The *Action de transfert* iBICOOP supports the development of the iBICOOP middleware towards its transfer to industry and more specifically its exploitation by the AMBIENTIC spin-off for the development of innovative, mobile collaborative services.
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. LABEX CominLabs

**Participants:** Anne-Marie Kermarrec, Davide Frey, Stéphane Weiss.

ASAP participates in the CominLabs initiative sponsored by the “Laboratoires d’Excellence” program. The initiative federates the best teams from Bretagne and Nantes regions in the broad area of telecommunications, from electronic devices to wide area distributed applications “over the top”. These include, among the others, the INRIA teams: ACES, ALF, ASAP, CELTIQUE, CIDRE, DISTRIBCOM, MYRIADS, TEMICS, TEXMEX, and Visages. The scope of CominLabs covers research, education, and innovation. While being hosted by academic institutions, the CominLabs build on a strong industrial ecosystem made of large companies and competitive SMEs.

8.1.2. ANR ARPÈGE project Streams

**Participants:** Achour Mostefaoui, Marin Bertier, Michel Raynal, Stéphane Weiss.

The Streams project started in November 2010. Beside the ASAP group, it includes Teams from INRIA Nancy and PARIS. Its aim it to design a real-time collaborative platform based on a peer-to-peer network. For this it is necessary to design a support architecture that offers guarantees on the propagation, security and consistency of the operations and the updates proposed by the different collaborating sites.

8.1.3. ANR VERSO project Shaman

**Participants:** Marin Bertier, Achour Mostefaoui, Anne-Marie Kermarrec, Michel Raynal.

The Shaman project started in 2009, gathering several members of the team working on distributed systems and distributed algorithms. The aim of this project is to propose new theoretical models for distributed algorithm inspired from real platform characteristics. From these models, we elaborate new algorithms and try to evaluate their theoretical power.

8.1.4. ANR Blanc project Displexity

**Participants:** Achour Mostefaoui, Anne-Marie Kermarrec, Michel Raynal.

The Displexity project started in October 2011. The aim of this ANR project that also involves researchers from Paris and Bordeaux is to establish the scientific foundations for building up a consistent theory of computability and complexity for distributed computing. One difficulty to be faced by DISPLEXITY is to reconcile two non necessarily disjoint sub-communities, one focusing on the impact of temporal issues, while the other is focusing on the impact of spatial issues.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. Gossple

**Participants:** Mohammad Alaggan, Antoine Boutet, Davide Frey, Arnaud Jegou, Anne-Marie Kermarrec, Konstantinos Kloudas, Afshin Moin, Heverson Ribeiro, François Taiani.

Title: Gossple
Type: IDEAS
Instrument: ERC Starting Grant (Starting)
Duration: September 2008 - August 2013
Coordinator: INRIA (France)
See also: [http://www.gossple.fr](http://www.gossple.fr)

Abstract: Anne-Marie Kermarrec is the principal investigator of the GOSSPLE ERC starting Grant (Sept. 2008 - Sept. 2013). GOSSPLE aims at providing a radically new approach to navigating the digital information universe. This project has been granted a 1,250,000 euros budget for 5 years.
GOSSPLE aims at radically changing the navigation on the Internet by placing users affinities and preferences at the heart of the search process. Complementing traditional search engines, GOSSPLE will turn search requests into live data to seek the information where it ultimately is: at the user. GOSSPLE precisely aims at providing a fully decentralized system, auto-organizing, able to discover, capture and leverage the affinities between users and data.

8.2.2. Collaborations in European Programs, except FP7

8.2.2.1. Transform Marie Curie Initial Training Network

Participants: Tyler Crain, Anne-Marie Kermarrec, Achour Mostefaoui, Michel Raynal.

Program: Marie Curie Initial Training Network
Project acronym: Transform
Project title: Theoretical Foundations of Transactional Memory
Duration: May 2010 - October 2013
Coordinator: Michel Raynal - Panagiota Fatourou

Other partners: Foundation for Research and Technology Hellas ICS FORTH Greece, University of Rennes 1 UR1 France, Ecole Polytechnique Federale de Lausanne EPFL Switzerland, Technische Universitaet Berlin TUB Germany, and Israel Institute of Technology Technion.

Abstract:
Transform is a Marie Curie Initial Training Networks European project devoted to the Theoretical Foundations of Transactional Memory (Grant agreement no.: 238639 Date of approval of Annex I by Commission: May 26, 2009). It involves the following universities: Foundation for Research and Technology Hellas ICS FORTH Greece, University of Rennes 1 UR1 France, Ecole Polytechnique Federale de Lausanne EPFL Switzerland, Technische Universitaet Berlin TUB Germany, and Israel Institute of Technology Technion.

Major chip manufacturers have shifted their focus from trying to speed up individual processors into putting several processors on the same chip. They are now talking about potentially doubling efficiency on a 2x core, quadrupling on a 4x core and so forth. Yet multi-core is useless without concurrent programming. The constructors are now calling for a new software revolution: the concurrency revolution. This might look at first glance surprising for concurrency is almost as old as computing and tons of concurrent programming models and languages were invented. In fact, what the revolution is about is way more than concurrency alone: it is about concurrency for the masses. The current parallel programming approach of employing locks is widely considered to be too difficult for any but a few experts. Therefore, a new paradigm of concurrent programming is needed to take advantage of the new regime of multicore computers. Transactional Memory (TM) is a new programming paradigm which is considered by most researchers as the future of parallel programming. Not surprisingly, a lot of work is being devoted to the implementation of TM systems, in hardware or solely in software. What might be surprising is the little effort devoted so far to devising a sound theoretical framework to reason about the TM abstraction. To understand properly TM systems, as well as be able to assess them and improve them, a rigorous theoretical study of the approach, its challenges and its benefits is badly needed. This is the challenging research goal undertaken by this MC-ITN. Our goal through this project is to gather leading researchers in the field of concurrent computing over Europe, and combine our efforts in order to define what might become the modern theory of concurrent computing. We aim at training a set of Early Stage Researchers (ESRs) in this direction and hope that, in turn, these ESRs will help Europe become a leader in concurrent computing. Its keywords are Transactional Memory, Parallelization Mechanisms, Parallel Programming Abstractions, Theory, Algorithms, Technological Sciences.
8.2.3. Major European Organizations with which Asap has followed Collaborations

- Ecole Polytechnique Federale de Lausanne EPFL Switzerland
  collaboration on Gossple ERC, Transform

- Foundation for Research and Technology Hellas ICS FORTH Greece
  Transform

- Technische Universitaet Berlin TUB Germany
  Transform

- Lancaster University
  Gossple

8.3. International Initiatives

8.3.1. Participation In International Programs

8.3.1.1. Demdyn: INRIA/CNPq Collaboration

Participants: Achour Mostefaoui, Marin Bertier, Michel Raynal.

The aim of this project is to exploit dependable aspects of dynamic distributed systems such as VANETs, WiMax, Airborn Networks, DoD Global Information Grid, P2P, etc. Applications that run on these kind of networks have a common point: they are extremely dynamic both in terms of the nodes that take part of them and available resources at a given time. Such dynamics results in instability and uncertainty of the environment which provide great challenges for the implementation of dependable mechanisms that ensure the correct work of the system.

This requires applications to be adaptive, for instance, to less network bandwidth or degraded Quality-of-Service (QoS). Ideally, in these highly dynamic scenarios, adaptiveness characteristics of applications should be self-managing or autonomic. Therefore, being able to detect the occurrence of partitions and automatically adapting the applications for such scenarios is an important dependable requirement for such new dynamic environments.

8.3.2. Visits of International Scientists


8.3.2.1. Internship

A. Moin was an intern at ETHZ from September 2011 to November 2011.

K. Kloudas was an intern at Imperial College of London from June to September 2011.

A. Boutet was an intern at the Computer Laboratory, University of Cambridge from July 2011 to September 2011.
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. CESSA: Compositional Evolution of Secure Services with Aspects (ANR/ARPEGE)

**Participants:** Mario Südholt <coordinator>, Hervé Grall, Diana Allam, Rémi Douence, Jean-Claude Royer.

The project CESSA is an (industrial) ANR project running for 36 months. It was accepted in Jun. 2009 for funding amounting to 290 KEUR for ASCOLA from Dec. 2009 on. Three other partners collaborate within the project that is coordinated by ASCOLA: a security research team from Eurecom, Sophia-Antipolis, the Security and Trust team from SAP Labs, also located at Sophia-Antipolis, and IS2T, an innovative start-up company developing middleware technologies located at Nantes. The project deals with security in service-oriented architectures.

This year our group has contributed several scientific publications as part of the project. All partners have been involved in the publication of two surveys on models for service-oriented architectures and security properties. Furthermore, they have set up a blog for SAP’s worldwide developer community. All information is available from the CESSA web site: [http://cessa.gforge.inria.fr](http://cessa.gforge.inria.fr).

8.1.2. Cool-IT (FUI)

**Participant:** Jean-Marc Menaud.

The Cool-IT project is an (industrial) FUI project running for 24 months. It was accepted in Sept. 2010 for funding amounting to 130 KEUR (ASCOLA only).

The objective of this project is to design systems adapted to new standards of “Green IT” to reduce the electrical consumption of data centers.

To this end, the COOL IT project develops processes for cooling computer servers, optimizes the servers power chain supply, implements tools and methods for collecting energy data in real time, and specifies methods for controlling the data centers consumption as a tradeoff between the computational power needed, its availability, and its energy consumption.

8.1.3. Entropy (ANR/Emergence)

**Participant:** Jean-Marc Menaud.

The Entropy project is an (industrial) ANR/Emergence project running for 18 months. It was accepted in Dec. 2010 for funding amounting to 242 KEUR (ASCOLA only).

The objective of this project is to conduct studies on economic feasibility (market, status, intellectual property, website) for creating an industrial business based on the Entropy software.

Some task must complete the Entropy core solution with a graphical unit interface to produce convincing demonstrators and consolidate our actual and future results. At the end of the project, the goal is to create a company whose objective is to sell the service, support and software building blocks developed by this ANR Emergence project.

8.1.4. MyCloud (ANR/ARPEGE)

**Participants:** Thomas Ledoux <coordinator>, Jean-Marc Menaud, Yousri Kouki, Frederico Alvares.

The MyCloud project is an ANR/ARPEGE project running for 42 months, starting in Nov. 2010. It was accepted in Jul. 2010 for funding amounting to 190 KEUR (ASCOLA only). MyCloud involves a consortium with three academic partners (INRIA, LIP6, EMN) and one industrial partner (We Are Cloud).
Cloud Computing is a paradigm for enabling remote, on-demand access to a set of configurable computing resources. However, the ad-hoc management of a cloud in terms of Quality of Service (QoS) and Service Level Agreement (SLA) poses significant challenges to the performance, availability, energy consumption and economical costs of the cloud.

The objective of MyCloud (http://mycloud.inrialpes.fr) is to define and implement a novel cloud model: SLAaaS (SLA as a Service). The SLAaaS model enriches the general paradigm of Cloud Computing and enables systematic and transparent integration of SLA to the cloud. From the cloud provider’s point of view, MyCloud proposes autonomic SLA management to handle performance, availability, energy and cost issues in the cloud. From the cloud customer’s point of view, MyCloud provides SLA governance allowing cloud customers to be part of the loop and to be automatically notified about the state of the cloud, such as SLA violation and cloud energy consumption.

This year, the ASCOLA project-team has proposed the global architecture and framework for the SLAaaS model and has provided a solution for self-optimisation of the energy footprint in cloud infrastructures [22].

8.1.5. SelfXL (ANR/ARPEGE)

Participant: Jean-Marc Menaud.

The SelfXL project is an (industrial) ANR/ARPEGE project running for 36 months. It was accepted in Jul. 2008 for funding amounting to 315 KEUR (ASCOLA only) from Jan. 2009 on.

The SelfXL project aims at investigating abstractions and implementation techniques (language mechanisms, runtime structures...) for complex and large-scale autonomic systems. The scope of this project encompasses any system that has a high software complexity (distributed, size of code etc.) and is large-scale in terms of size and heterogeneity of resources and software. Systems to be targeted range from cluster computing to embedded systems, including legacy software.

Two main issues will be addressed by SelfXL: How to implement administration policies for complex system and how to coordinate administration policies in a complex system? Regarding the first issue, SelfXL proposes to explore the DSL programming approach, i.e., designing specific languages for defining specific kinds of administration policies (self-repair, self-optimization, self-protection). The general use of DSLs would ensure the correctness of the policies.

We propose to design a decision module based on Constraints Programming (CP). As the Rules Based Systems (RBS) or the Event Condition Action (ECA) approach, CP belongs to the declarative paradigm but does not share the major drawback of the other approaches when some rules are simultaneously asserted. This is the case when there is an overlap between the domain or the target of rules.

Finally, we propose to extend the Jasmine autonomic administration platform (http://wiki.jasmine.objectweb.org) for supporting a decentralized and hierarchical infrastructure to address the large-scale administration.

8.2. European Initiatives

8.2.1. SCALUS: SCALing by means of Ubiquitous Storage (MC ITN)

Participant: Adrien Lèbre.

The vision of the Scalus Marie Curie international training network (MC ITN) is to deliver the foundation for ubiquitous storage systems, which can be scaled with respect to multiple characteristics (capacity, performance, distance, security, ...).

Providing ubiquitous storage will become a major demand for future IT systems and leadership in this area can have significant impact on European competitiveness in IT technology. To get this leadership, it is necessary to invest into storage education and research and to bridge the current gap between local storage, cluster storage, grid storage, and cloud storage. The consortium will proceed in this direction by building the first interdisciplinary teaching and research network on storage issues. It consists of top European institutes and companies in storage and cluster technology, building a demanding but rewarding interdisciplinary environment for young researchers.
The network involves the following partners: University of Paderborn (Germany, coordinator), Barcelona Super Computing (Spain), University of Durham (England), University of Frankfurt (Germany), ICS-FORTH (Greece), Universidad Politécnica de Madrid (Spain), EMN/ARMINES (France), INRIA Rennes Bretagne Atlantique (France), XLAB (Slovenia), University of Hamburg (Germany), Fujitsu Technology Systems (Germany).

The overall funding of the project by the European Union is closed to 3.3 MEUR. ASCOLA’s share amounts to 200 KEUR.

8.2.2. COST IC0804

Participant: Jean-Marc Menaud.

The COST IC 0840 Action will propose realistic energy-efficient alternate solutions to share IT distributed resources. As large scale distributed systems gather and share more and more computing nodes and storage resources, their energy consumption is drastically increasing. While much effort is nowadays put into hardware specific solutions to lower energy consumptions, the need for a complementary approach is necessary at the distributed system level, i.e. middleware, networks and applications. The action will characterize the energy consumption and energy efficiencies of distributed applications.  http://www.cost804.org/

8.3. International Initiatives

8.3.1. INRIA Associate Teams

8.3.1.1. RAPIDS

- Title: Reasoning about Aspect-oriented Programs and security in Distributed Systems
- INRIA principal investigator: Jacques Noyé
- International Partner:
  - Institution: University of Chile (Chile)
  - Laboratory: Computer Science Department
- Duration: 2010 - 2012
- See also: http://rapids.gforge.inria.fr/doku.php
- While Aspect-Oriented Programming offers promising mechanisms for enhancing the modularity of software, this increased modularity raises new challenges for systematic reasoning. This project studies means to address fundamental and practical issues in understanding distributed aspect-oriented programs by focusing on the issue of security. To this end, the project tackles three complementary lines of work: 1. Designing a core calculus to model distributed aspect-oriented programming languages and reason about programs written in these languages. 2. Studying how aspects can be used to enforce security properties in a distributed system, based upon guarantees provided by the underlying aspect infrastructure. 3. Designing and developing languages, analyses and runtime systems for distributed aspects based on the proposed calculus, therefore enabling systematic reasoning about security. These lines of work are interconnected and confluent.

8.3.2. Visits of International Scientists

8.3.2.1. Invited Researchers and Professors

- Prof. Awais Rashid (from Feb. until Mar. 2011)
  - Subject: Sustainable Software for a Sustainable World
  - Institution: Lancaster University, U.K.
  - Pays de la Loire regional chair in Computer Science at École des Mines de Nantes, 2009-2011
8.3.2.2. Internships

- Mohammad Mohammad Atiqul Haque (from Mar. until Jul. 2011)
  Subject: Impact of dynamic VM scheduling in cloud platforms
  Institution: Colorado State University (United States)
  INRIA grant

- Mauricio De Diana (from Mar. until Jul. 2011)
  Subject: Federation of distributed file systems for grid and cloud architectures
  Institution: Universidade de São Paulo (Brazil)
  INRIA grant
8. Partnerships and Cooperations

8.1. Regional Initiatives

Program: Pays de la Loire regional funding. Call: Soutenir et accompagner la constitution et/ou l’implantation de nouvelles équipes sur des thématiques émergentes

Project title: AtlanMod New Team Creation
Duration: 2011 - 2014
Coordinator: AtlanMod

Abstract: AtlanMod has been funded by the Pays de la Loire Regional Council new research teams program. This funding will mainly cover a PhD Student and two years of a postdoc to work on the quality of models research line.

8.2. National Initiatives

Program: ANR - ARPEGE program
Project acronym: Galaxy
Project title: Galaxy
Duration: 2010 - 2013
Coordinator: Airbus

Other partners: Industry (Airbus), Research and University (Armines -AtlanMod-, IRIT, LIP6) and Vendors and service providers (AKKA, Softeam)

Abstract: GALAXY (http://galaxy.lip6.fr) proposes to deal with the model driven collaborative development of complex systems. Galaxy aims at defining an open and flexible architecture particularly designed to be scalable. One of the key points is related to the fragmentation and distributiveness of huge models, their synchronization and relationship with communication means classically used by development teams. The work is being driven by use cases provided by a company (Airbus), which describe scalability issues they face during systems developments. Our work in this project is composed of two main parts: 1) the conception of efficient mechanisms for multiple views of complex (large) models; 2) the definition of a solution for the automation of modeling tasks on large model repositories, like the execution of large amounts of transformations, the orchestration of their execution, and the effective browsing of repositories for finding specific models. In this context we have developed MoScript, a scripting language (and corresponding execution engine) to write batch processing modeling tasks.

Program: ANR
Project acronym: IDM++
Project title: Ingénierie dirigée par les modèles ++
Duration: 2008 - 2011
Coordinator: IBM (ILog)
Other partners: CEA, Mia-Software, Prima Solution
Abstract: IdM++ (http://www.emn.fr/x-info/idmpp/index.php/Accueil) main goal is to investigate advanced issues in model engineering. The IDM++ consortium proposes the combination of Global Model Management and Model Configuration techniques. The goal is to bring together two different communities: the Model-Driven Engineering (MDE) community and the logic programming community, to explore how each community can benefit from the techniques of the other. We refer to the logic programming community in a broad sense (i.e. including Constraint Logic Programming, Answer-Set Programming but also ontology and semantic web aspects).

This approach is promoted according to the partners background in Model Driven Engineering, Constraint based programming and optimization techniques. The team is particularly in charge of WP 2, on global model management.

8.3. European Initiatives

Program: Artemis
Project acronym: CESAR
Project title: Cost-Efficient methods and processes for SAfety Relevant embedded systems
Duration: 2009 - 2012
Other partners: More than 50 partners
Abstract: The three transportation domains, automotive, aerospace, and rail, as well as the automation domain share the need to develop ultra-reliable embedded systems to meet social demands for increased mobility and safety in a highly competitive global market. To maintain the European leading edge position in the transportation as well as automation market, CESAR aims to boost cost efficiency of embedded systems development and safety and certification processes by an order of magnitude. CESAR pursues a multi-domain approach integrating large enterprises, suppliers, SME’s and vendors of cross sectoral domains and cooperating with leading research organizations and innovative SME’s. In particular, we work on the Reference Technology Platform, which aims at tool integration. We propose to achieve tool integration by means of metamodeling and model transformations [46]. In the context of this project we are developing VirtualEMF (http://code.google.com/a/eclipselabs.org/p/virtual-emf/), an approach and tool for the transparent composition, weaving and linking of heterogeneous models.

Program: ITEA2
Project acronym: OPEES
Project title: Open Platform for the Engineering of Embedded Systems
Duration: 2009 - 2012
Coordinator: Obeo
Other partners: Many other research labs and companies
Abstract: OPEES (http://www.opees.org) mission statement is to settle a community and build the necessary means and enablers to ensure long-term availability of innovative engineering technologies in the domain of dependable or critical software-intensive embedded systems. In particular, within OPEES, our schema of open source industrial collaboration [37] (e.g. around ATL) will be tested and developed as a team contribution to this project. AtlanMod is also responsible for providing a model-driven interoperability solution for the integration of the ecosystem of OPEES components, based on metamodeling the domain data of each component and bridging, by model transformation, the specific data representations.

8.3.1. Collaborations in European Programs, except FP7

Program: Leonardo da Vinci (LifeLong learning programme)
Project acronym: MDEExpertise
Project title: Exchanging knowledge, techniques and experiences around Model Driven Engineering education
Duration: 2010 - 2012
Coordinator: Lublin University of Technology
Other partners: Politecnico di Milano, Universidad de Alicante
Abstract: MDE Expertise (http://www.learnMDE.org) is an European Leonardo da Vinci project focused on the development of common educational materials for the Model Driven Engineering (MDE) area. The main aim of the project is to transfer and adapt the education in Model Driven Engineering concepts to the local IT education societies of the partner’s countries, thus improving the partners’ knowledge about up to date current software development methods. This results in the best preparation for professionals competing on the IT market. Direct results include: development of common MDE teaching methods, suited for the partners’ local needs and market requirements; creation of teaching materials (with online version) localized for the partners’ languages and definition of tools for e-learning and knowledge exchange. Indirect effects include improving the capability of local SMEs in solving complex software design problems through modeling, and evolving the software development job market.

8.4. International Initiatives

8.4.1. INRIA International Partners

AtlanMod keeps a close and continuous collaboration with a number of foreign research group. To mention the top 5:

- Vienna University of Technology. Collaboration on model transformations (refactoring, refinement, evolution,...)
- University of Bremen. Collaboration on model validation and verification.
- Technical University of Barcelona. Collaboration on conceptual modeling, semantics of modeling primitives, code-generation and the like.
- Politecnico di Milano. Collaboration on modeling in a web engineering context and on model search problems in repositories.
- University of Toronto. Collaboration on intentional models, requirements engineering and social modeling topics.

8.4.2. Visits of International Scientists

In 2011 three visitors did a research stay with AtlanMod:

- Dennis Wagelaar (Vrije Universiteit Brussel, Belgium), January-February
- Jesus Gallardo (Universidad de Castilla la Mancha, Spain), July
- Jokin Garcia (University of the Basque Country, Spain), May

8.4.2.1. Internship

Víctor García from the technical university of Valencia did his master thesis in AtlanMod, in the context of our MoDisco project.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Projet Région Aquitaine : Performance modeling for heterogeneous platforms

Participants: Lionel Eyraud-Dubois, Olivier Beaumont, Nicolas Bonichon.

This project in coordination with the INRIA project RUNTIME aims at designing models for communication times on heterogeneous platforms of two types: high-scale platforms for volunteer computing, and high performance NUMA machines. The goal is to reach a compromise between precision and algorithmic tractability.

8.2. National Initiatives

8.2.1. ANR "programme blanc" Aladdin (2007-2011)


The scientific objectives of ALADDIN are to solve what are identified as the most challenging problems in the theory of interaction networks. The ALADDIN project is thus an opportunity to create a full continuum from fundamental research to applications in coordination with both INRIA projects CEPAGE and GANG.

8.2.2. ANR programme "défis": project IDEA (2009-2012)

Participant: Ralf Klasing.

The goal of this ANR is the study of identifying codes in evolving graphs. Ralf Klasing is the overall leader of the project.

8.2.3. ANR “USS SimGrid” (2008-2011)

Participants: Olivier Beaumont, Nicolas Bonichon, Lionel Eyraud-Dubois.

The objectives of USS SimGrid is to create a simulation framework that will answer (i) the need for simulation scalability arising in the HPC community; (ii) the need for simulation accuracy arising in distributed computing. The Cepage team will be involved in the development of tools to provide realistic model instantiations.

The project involves the following INRIA and CNRS teams: AlGorille, ASAP, Cepage, Graal, MESCAL, SysCom, CC IN2P3.

8.2.4. ANR "programme blanc" Displexity (2012-2015)

Participants: Cyril Gavoille, David Ilcinkas, Ralf Klasing, Adrian Kosowski.

The main goal of DISPLEXITY (for DIStributed computing: computability and ComPLEXITY) is to establish the scientific foundations for building up a consistent theory of computability and complexity for distributed computing. The other partners are from IRISA (Rennes) and LIAFA (Paris).

8.2.5. ANR “SONGS” (2012-2016)

Participants: Olivier Beaumont, Nicolas Bonichon, Lionel Eyraud-Dubois.
SONGS (Simulation of Next Generation Systems) is a follow-up to the USS-SimGrid project. Its objective is to design a unified and open simulation framework for performance evaluation of next generation systems: Grids, Peer-to-Peer systems, Clouds and HPC systems. Cepage will be involved in the Peer-to-peer and Cloud use cases by designing and testing efficient allocation policies. Cepage will also take part in the design of efficient and realistic models and their validation.

The project involves the following INRIA and CNRS teams: AlGorille, ASCOLA, AVALON, CEPAGE, HiePACS, ICPS, MASCOTTE, MODALIS, MESCAL, RUNTIME, CC IN2P3.

8.3. European Initiatives

8.3.1. FP7 Projet

8.3.1.1. EULER

Title: EULER (Experimental UpdateLess Evolutive Routing)
Type: COOPERATION (ICT)
Defi: Future Internet Experimental Facility and Experimentally-driven Research
Instrument: Specific Targeted Research Project (STREP)
Duration: October 2010 - September 2013
Coordinator: ALCATEL-LUCENT (Belgium)
Others partners:
- Alcatel-Lucent Bell, Antwerpen, Belgium
- 3 projects from INRIA: CEPAGE, GANG and MASCOTTE, France
- Interdisciplinary Institute for Broadband Technology (IBBT), Belgium
- Laboratoire d’Informatique de Paris 6 (LIP6), Université Pierre Marie Curie (UPMC), France
- Department of Mathematical Engineering (INMA) Université Catholique de Louvain, Belgium
- RACTI, Research Academic Computer Technology Institute University of Patras, Greece
- CAT, Catalan Consortium: Universitat Politècnica de Catalunya, Barcelona and University of Girona, Spain

See also: http://www-sop.inria.fr/mascotte/EULER/wiki/

Abstract: The title of this study is "Dynamic Compact Routing Scheme". The aim of this projet is to develop new routing schemes achieving better performances than current BGP protocols. The problems faced by the inter-domain routing protocol of the Internet are numerous:

1. The underlying network is dynamic: many observations of bad configurations show the instability of BGP;
2. BGP does not scale well: the convergence time toward a legal configuration is too long, the size of routing tables is proportional to the number of nodes of network (the network size is multiplied by 1.25 each year);
3. The impact of the policies is so important that the many packets can oscillated between two Autonomous Systems.
In this collaboration, we mainly focus on the scalability properties that a new routing protocol should guarantee. The main measures are the size of the local routing tables, and the time (or message complexity) to update or to generate such tables. The design of schemes achieving sub-linear space per routers, say in $n$ where $n$ is the number of AS routers, is the main challenge. The target networks are AS-network like with more than 100,000 nodes. This project, in collaboration with the MASCOTE INRIA-project in Nice Sophia-Antipolis, makes the use of simulation, developed at both sites.

8.3.1.2. Royal Society Grant with the University of Liverpool

**Participants:** Nicolas Hanusse, David Ilcinkas, Ralf Klasing, Adrian Kosowski.

International Joint Project, 2011-2013, entitled “SEarch, RENdezvous and Explore (SERENE)”, on foundations of mobile agent computing, in collaboration with the Department of Computer Science, University of Liverpool. Funded by the Royal Society, U.K. Principal investigator on the UK side: Leszek Gasieniec. Ralf Klasing is the principal investigator on the French side.

8.3.1.3. European COST Action ComplexHPC (2009-2012)

**Participants:** Olivier Beaumont, Nicolas Bonichon, Lionel Eyraud-Dubois.

The goal of ComplexHPC is to coordinate European groups working on the use of heterogeneous and hierarchical systems for HPC as well as the development of collaborative activities among the involved research groups, to tackle the problem at every level (from cores to large-scale environments) and to provide new integrated solutions for large-scale computing for future platforms (see [http://complexhpc.org/index.php](http://complexhpc.org/index.php)).

8.3.1.4. Emergent Project with the University of Perugia

**Participants:** David Ilcinkas, Ralf Klasing, Adrian Kosowski.

International Joint Project, 2011, on foundations of mobile agent computing, in collaboration with the Department of Computer Science, University of Perugia, Italy. Principal investigator on the Italian side: Alfredo Navarra. Ralf Klasing is the principal investigator on the French side.

8.3.2. Major European Organizations with which you have followed Collaborations

Marcin Markiewicz, University of Gdansk (Poland)
Quantum distributed computing models and simulation of quantum correlations using classical information channels.

Ashley Deflumere and Alexey Lastovetsky, University College Dublin (Ireland)
Design of efficient distribution scheme for linear algebra kernels on modern heterogeneous architectures

Gabriele Di Stefano, University of L’Aquila (Italy)
Mobile agent coordination in distributed computing.

Miroslaw Korzeniowski, Technical University of Wroclaw (Poland)
Design of distributed and randomized algorithms for P2P networks.

Leszek Gasieniec, University of Liverpool (UK)
Design of distributed algorithms for mobile agents in exploration and patrolling tasks.

Guido Proetti, University of L’Aquila (Italy)
Davide Bilo, University of Sassari (Italy)  
Network discovery and verification. ation techniques for chosen task scheduling problems.

Tobias Mömke, KTH Royal Institute of Technology, Stockholm (Sweden)  
Centralized approximation techniques for chosen task scheduling problems.

Thomas Sauerwald, Max-Planck-Institut für Informatik, Saarbrücken (Germany)  
Propp machine, Multiple random walks.

8.4. International Initiatives

8.4.1. Visits of International Scientists

8.4.1.1. Visits to Cepage Members

- Ashley Deflumere, University College Dublin, 04/12 - 17/12/2011
- Alfredo Navarra, University of Perugia, Italy, 11/12-16/12/2011
- Ljubomir Perkovic, De Paul University Chicago, (September 2011–)
- Miroslaw Korzeniowski, Technical University of Wroclaw, (23/08- 28/08/2011)
- Marcin Markiewicz, University of Gdansk, 10/05-17/05/2011
- Miroslaw Korzeniowski, Technical University of Wroclaw, (06/07- 22/07/2011)
- Tobias Mömke, KTH Royal Institute of Technology, Stockholm, Sweden, 17/07 - 31/07/2011
- Leszek Gasieniec, University of Liverpool, UK, 10/09-17/09/2011
- Alfredo Navarra, University of Perugia, Italy, 10/09-17/09/2011
- Gabriele Di Stefano, University of L’Aquila, Italy, 10/09-17/09/2011
- Davide Bilo, University of Sassari, Italy, 27/11-07/12/2011

8.4.1.2. Visits of Cepage Members

- Microsoft Research Montainview, CA, invited research visit by I. Abhram (C. Gavoille, 10 days, April 2011)
- Weizmann Institute, research visit with D. Peleg (Q. Godfroy, one week, November 2011)
- Universidad Adolfo Ibanez, Chile, research visit as part of joint grant (A. Kosowski, 16/01-03/02/2011)
- University of Gdansk, Poland, research visit (A. Kosowski, 07/02-14/02/2011)
- University of Liverpool, UK, research visit as part of joint grant (A. Kosowski, 15/02-27/02/2011)
- Carleton University, Canada, invited research visit (A. Kosowski, 08/11-20/11/2011)

8.4.1.3. Internship

8.4.1.4. Major Non-European Organizations with which you have followed Collaborations

- Weizmann Institute (IL), David Peleg
- MIT (USA), Christian Sommer
- MicroSoft Research, Montainview (USA), Ittai Abraham

8.4.2. Participation In International Programs

8.4.2.1. Foreign partner of ANILLO grant at Universidad Adolfo Ibanez

Participant: Adrian Kosowski.
Foreign partner of the project entitled “Mathematical modeling for industrial and management science” funded by the Government of Chile through its CONICYT program (ANILLO for Science and Technology).
This grant involves research into mathematical programming models, network dynamics and graph models, stochastic models, as well as other interdisciplinary projects. The joint work performed during the research collaboration lead to new results on the computational power of interconnection networks in distributed computing, and to new algorithms for compact routing in special graph classes.

8.4.2.2. Foreign partner of Comunidad de Madrid grant

Participants: Olivier Beaumont, Lionel Eyraud-Dubois.

Foreign partner of the project entitled “CLOUDS: Cloud Computing para Servicios Escalables, Confiables y Ubicuos” (2010-2013) funded by the Comunidad de Madrid.
8. Partnerships and Cooperations

8.1. Regional Initiatives

The PhD of Regina Marin (on privacy protection in distributed social networks) is supported by a ARED grant (with Région Bretagne).

8.2. National Initiatives

  POLUX aimed at configuring automatically the security mechanisms (prevention and detection) from the specification of the system in terms of its security policy. Indeed, current security tools are totally uncoordinated. They come from a large number of vendors. Even worse, they are sometimes developed by newcomers to the security field and they use different configuration logics and languages that bear little resemblance one to another or to the previously proposed formalisms. As a result, ensuring interoperability between these tools is a difficult endeavor. Researchers are facing the same issues, different communities looking at either access control, security protocols or intrusion detection, but with little coordination or fusion between these domains. A few standard formats have been defined over the years, but they only cover small areas, and they have been very long in the making. We first studied this interoperability problem and developed a framework allowing a unified expression of security policies for the entire range of security tools related to prevention of security issues, detection of threats, and countermeasures. The expression of these security policies obeyed precise constraints permitting the verification of their soundness and the validation of their application to a particular information system. It also allowed interoperability and negotiation of security policies and included the management of the security policy as a meta-policy. This project is led by Télécom Bretagne and involves Supélec.

  PLACID is an interdisciplinary project that combines expertise in artificial intelligence and computer security. Alarm correlation is a subfield of intrusion detection whose goal is to make heterogeneous IDS sensors cooperate in order to improve the attack detection rate, enrich the semantics of alerts and reduce the overall number of alerts. Several solutions have been proposed in the literature, all of which require knowledge about the attacks and the context in which they occur. At the same time, complementary tools have appeared to support alarm correlation by providing knowledge databases about attacks, as well as local and global contextual observations. However, none of these correlation solutions received a wide acceptance. We believe that one of the reason for this is that the intrusion detection domain lacks a common logic that would allow security systems to reason about complementary evidences and security operators to interact with these systems efficiently. The objective of the PLACID project is twofolds. First we investigate a formal description logic for intrusion detection, called IDDL, which stands for Intrusion Detection Description Logic. IDDL will provide security components with a formal framework to characterize their observation, share their knowledge with third-party components and reason about complementary evidence information. Second, we investigate bayesian-based approaches for alert correlation. Our aim is to model uncertainty associated with alerts, to represent malicious actions, and to model correlation relations between alerts. The use of bayesian networks has several advantages such as evaluating the success of attacks, reducing the set of possible attacks scenarios, learning correlation relations, or finding the root cause of alerts. This project is led by the University of Nantes and involves the University of Artois and Supélec.
• **ANR Arpege Project: DALI (2009-2011)**

DALI aims at developing innovative design solutions to enhance the capabilities of current intrusion detection systems at the application level as well as new methodologies and tools for assessment and evaluation of the proposed solution with respect to their ability to detect potential intrusions. We expect to enhance the detection capability by inserting the mechanisms directly inside the software. Our work focuses on two complementary methods: First, the specification of software security contracts in terms of application level security policy, and second, an introspective method to learn the software specification at run-time. Both methods will lead to instrument the software to insert intrusion detection mechanisms. The challenges that will be addressed include the identification of the security attributes which must be captured by contracts, the ability to have enough introspection at run-time to learn program behavior, and finally the ability to instrument automatically the software. Our analysis of the state of the art reveals that there is still a lack of rigorous methodologies defining how the developers should proceed for testing security and a lack of tools supporting the implementation of such a methodology. Our project aims at fulfilling these two objectives. One of our objectives is to develop a uniform, repeatable, and cost-effective way to test and evaluate IDS, either as a stand-alone assessment or, more often, for comparative evaluation across systems and components. Particular attention is put on the generation of inputs combining normal and malicious activities and the definition of input selection criteria taking into account the security properties and the specification of the application. Moreover, in the context of the project, we will develop a platform that will permit to show the feasibility of the different approaches in the project, both in terms of intrusion detection design and assessment.

This project is led by Kereval and involves Télécom Bretagne, Supélec and the LAAS/ CNRS.

• **ANR SeSur Project: LISE (2008-2011)**

The LISE project intends to study the relationship between law and technique in the realization of secure computing systems. In particular, solutions for assessing and proving the responsibility of parties should be defined. LISE follows a top-down approach, starting with the definition of liability and deriving sufficient and acceptable execution traces. The main phases of the project are as follows: (1) State of the art and recommendations for potential evolutions of current regulations in order to make them suitable to the new ICT society and to favor the emergence of a true “liability economy” of software. (2) Method for software liability specification and definition of a legally acceptable link with execution traces. (3) Method for the analysis of execution traces to determine liability based on the agreed specification.

This project is led by INRIA Rhône-Alpes and involves the University of Versailles Saint-Quentin-en-Yvelines, the University of Caen Basse-Normandie, Supélec and VERIMAG.

• **ANR INS Project: AMORES (2011-2015)**

Situated in the mobiquitous context characterized by a high mobility of individuals, most of them wearing devices capable of geolocation (smartphones or GPS-equipped cars), the AMORES project is built around three use-cases related to mobility, namely (1) dynamic carpooling, (2) real-time computation of multi-modal transportation itineraries and (3) mobile social networking. For these three use cases, the main objective of the AMORES project is to define and develop geo-communication primitives at the middleware level that can offer the required geo-located services, while at the same time preserving the privacy of users, in particular with respect to their location (notion of geo-privacy). This project is joint between the Université de Rennes 1, Supélec, LAAS-CNRS, Mobigis and Tisséo.

• **ANR INS Project : LYRICS (2011-2014)**

With the fast emergence of the contactless technology such as NFC, mobile phones will soon be able to play the role of e-tickets, credit cards, transit pass, loyalty cards, access control badges, e-voting tokens, e-cash wallets, etc. In such a context, protecting the privacy of an individual becomes a particularly challenging task, especially when this individual is engaged during her daily
life in contactless services that may be associated with his identity. If an unauthorized entity is technically able to follow all the digital traces left behind during these interactions then that third party could efficiently build a complete profile of this individual, thus causing a privacy breach. Most importantly, this entity can freely use this information for some undesired or fraudulent purposes ranging from targeted spam to identity theft. The objective of LYRICS (ANR INS 2011) is to enable end users to securely access and operate contactless services in a privacy-preserving manner that is, without having to disclose their identity or any other unnecessary information related to personal data. The project is joint between France Télécom, Atos Wordline, CryptoExperts, ENSI Bourges, ENSI Caen, MoDyCo, Oberthur Technologies, NEC Corporation, Microsoft and Université de Rennes 1.

- **LABEX Comin Labs**
  
  CIDRE participates in the CominLabs initiative sponsored by the “Laboratoires d’Excellence” program and which federates the best teams from Bretagne and Nantes regions in the broad area of telecommunications, from electronic devices to distributed applications. We are in particular involved in the “security and privacy” focus that is co-chaired by a member of the team.

### 8.3. European Initiatives

- **Quaero**
  
  CIDRE is involved in the Quaero project. Quaero is a program promoting research and industrial innovation on technologies for automatic analysis and classification of multimedia and multilingual documents. The partners collaborate on research and the realisation of advanced demonstrators and prototypes of innovating applications and services for access and usage of multimedia information, such as spoken language, images, video and music. The Quaero consortium (composed of French and German public and private research organisations) is coordinated by Technicolor.

  Sébastien Gambs is involved in one of the task (led by Amedeo Napoli, équipe INRIA Orpailleur) of the Quaero project whose aim is to study the implications in terms of privacy for a user to participate in personalized applications (such as video-on-demand) adapted to the user context, background and preferences as well as proposing solutions that can contribute to enhance this privacy. On one hand using personal data to tailor the content to the user needs may be important for improving the quality of service and its relevance but on the other hand this raises serious privacy issues regarding how this data will be collected, used and disseminated. The main purpose of the solutions developed in this task is to enable an individual to access personalized content/service in a privacy-preserving manner and without having to disclose any unnecessary personal information. Since November 2011, Julien Lolive has also join the project as an engineer.

- **EIT ICT Labs**
  
  EIT ICT Labs is one of the first three Knowledge and Innovation Communities (KICs) selected by the European Institute of Innovation & Technology (EIT) to accelerate innovation in Europe.

  Nowadays, Information Technologies have invaded many aspects of the daily lives of individuals, thus creating a lot of new possibilities but also raising privacy concerns to the point that some individuals feel that they no longer have suitable guarantees or any control about their privacy. Indeed, protecting the privacy of individuals is one of the main challenges of the « Information Society » but is difficult to achieve as individuals constantly leave digital traces of their actions and whereabouts, often without even knowing it. If an unauthorized entity gathers these digital traces, he (or she) can use them for malicious purposes ranging from targeted spam to profiling, and even identity theft.

  The goal of the action line “Protection of Privacy in the Information Society” (created by Sébastien Gambs together with Daniel Le Métayer and Claude Castelluccia from INRIA Rhône-Alpes) is to address the new challenges raised by the most recent developments and usages of information technologies (e.g., geo-located applications, social networking sites, profiling, pervasive computing, data
mining) by providing solutions to enhance the privacy protection of individuals in the Information Society. Essentially, this action line is transversal to most of the thematic and research action lines of EIT ICT labs and it is envisioned that it should also contribute to their developments. While the action line was originally intended to focus on privacy, its scope was recently extended to include security and trust thus being renamed as “Security, Privacy and Trust in the Information Society”. In 2012, Sébastien Gambs will lead an activity in this action line related to location privacy that involves partners coming from 3 different nodes of EIT ICT labs.

8.4. International Initiatives

8.4.1. INRIA International Partners

**CANADA**: Sébastien Gambs is co-supervising Ai Thanh Ho, a PhD student from the Université de Montréal with whom he has been actively collaborating for 2 years on the subject of privacy issues in social networking sites. The main supervisor of Ai Thanh Ho is Esma Aïmeur (full professor, Université de Montréal). Ai Thanh Ho has visited us in November 2011. In 2011, this cooperation has led to a joint publication [23].

**BRAZIL**: Francisco Brasilieiro, Professor at the Federal University of Paraiba (Campina Grande) was involved with us in a four years Capes/Cofecube project (2005-2009). We still cooperate with him on the dependability evaluation of cluster-based systems [15].

We have also strong links with University of Brasilia (Brazil) and in particular with Prof. Rafael de Sousa (Brasilia) who has spent one year and an half in Supélec (March 2006 to August 2007). With his team, we study the concept of trust in the context of mobile ad hoc networks.

**AUSTRALIA**: With Queensland University of Technology (QUT, Brisbane) we cooperate to study policy-based intrusion detection problems. Jacob Zimmermann (QUT) spent one month in Supélec (January 2007). Two people from Supélec (Benjamin Morin and Ludovic Mé) visited QUT in September 2007. Andrew Clark (QUT) spent 3 months in Supélec from August to November 2009. The PhD thesis of Christophe Hauser, “Détection d’intrusions dans les systèmes distribués”, started in October 2009, is supervised jointly with Queensland University of Technology, Brisbane, Australia (Prof. Andrew Clarke). Since February 2011, Christopher Hauser works in Brisbane. His one year visit is supported by a grant from Rennes Métropole.

8.4.2. Visits of International Scientists

**ALGERIA**: Linda Zeghache, Phd student at USTBH-CEDRIC (université des Sciences et de la Technologie Houari Boumédiène, Algeria) visited us during one month in December 2010/January 2011. This cooperation has led to a joint publication in 2011 [33].

**CANADA**: Frédéric Massicotte from the “Communications Research Centre Canada” has visited us in March 2011. The CRC is the federal government’s primary laboratory for research and development in advanced telecommunications.

**CHINA**: Chuanyou Li, PhD student at Southeast University (Nanjing, China) is visiting us during a period of one year (December 2011 - November 2012). Since the end of a LIAMA project (2000-2002), strong relationships are maintained with the research team of Prof. Yun Wang of Southeast university. The joint works focus mainly on fault-tolerance in distributed systems and security in ad hoc networks.

8.4.3. Participation In International Programs

CIDRE participates to a project for the ICST Algeria program (Information and Communication Science and Technology). The title of the project is “Utilisation de la plate-forme de test Senslab pour le projet irrigsense”. This 2-year project (2011-2012) is leaded by the Project-Team DIONYSOS and involves two other INRIA teams ASAP, CIDRE. The CERIST represents the Algerian partner. The project focuses on using the senslab node of Rennes, for testing different protocols developed by the partners in the context of an Algerian project which aims at using sensors for agricultural irrigation.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. ARED Région Bretagne

Participant: Bruno Tuffin.

ARED contract (with Région Bretagne) for the PhD thesis of Sagga Samira on rare event simulation with applications in telecommunications.

8.1.2. SISCom International Research Chair "Future Telecommunication Ecosystems"

Participants: Peter Reichl, Bruno Tuffin.

Cross-connecting related activities at SISCom partners (INRIA Rennes ? Bretagne Atlantique, Télécom Bretagne Rennes, and CNRS) and the Telecommunications Research Center Vienna (FTW), Austria, the main goal of the SISCom International Chair on "Future Telecommunication Ecosystems" is to develop an overall perspective of current and future research in this holistic area where user-driven research and microeconomic modeling meet the technical challenges of future telecommunications. Additionally, selected research questions in the areas of Quality of Experience, game theoretic models of cooperation and competition between users and/or providers, and future pervasive interaction will be addressed more specifically and may serve as starting points for joint follow-on activities, thus supporting the sustainability of this initiative.

The SISCom International Research Chair is funded jointly by Université Europèenne de Bretagne, Région Bretagne, and the European Regional Development Fund, and is hosted by INRIA Rennes Bretagne-Atlantique for the period December 2010 through September 2011.

8.2. National Initiatives

8.2.1. ARC MENEUR

Participants: Pierre Coucheney, Peter Reichl, Bruno Tuffin.

We coordinate an INRIA cooperative research action on Network Neutralité, called MENEUR (Modélisation en Economie des réseaux et NEUtRalité du Net). This action runs over 2011-2012 in association with INRIA teams MAESTRO and MESCAL, Orange Labs, ALU-Bell Labs France, Telecom Bretagne, FTW (Austria), Columbia University and Penn State University.

The goal of this project is to study the interest of network neutrality, a topic that has recently gained a lot of attention. The project aims at elaborating mathematical models that will be analyzed to investigate its impact on users, on social welfare and on providers’ investment incentives, among others, and eventually propose how (and if) network neutrality should be implemented.

See http://www.irisa.fr/dionysos/pages_perso/tuffin/MENEUR/

8.3. European Initiatives

8.3.1. NoE EuroNF

Participants: Gerardo Rubino, Bruno Tuffin.

EuroNF Euro-NF is a Network of Excellence on the Network of the Future, formed by 35 institutions (from the academia and industry) from 16 countries. Its main target is to integrate the research effort of the partners to be a source of innovation and a think tank on possible scientific, technological and socio-economic trajectories towards the network of the future. It has started in January 2008 and is ending in June 2012 (see http://euronf.enst.fr/en_accueil.html ).
Bruno Tuffin is the INRIA team leader in this project.

The group is contributing to the following working packages (Joint Research Activities):

- WPJRA.2.2: Traffic Engineering, Mechanisms and Protocols for Controlled Bandwidth Sharing;
- WPJRA.2.4: Routing and Traffic Management in a Multi-Provider Context;
- WPJRA.2.5: Design of Optimal Highly Dependable Networks;
- WPJRA.3.2: SLAs, Pricing, Quality of Experience;
- WPJRA.3.3: Cost Models.

8.3.2. AMESA project

**Participant:** Bruno Tuffin.

We are member of AMESA project (Analysis of MEchanisms for Sponsored search Auctions) within EuroNF NoE, funded for a period of about one year Oct. 2009 and Dec. 2011, in collaboration with, Athens University of Economics and Business, the CWI, TELECOM Bretagne and the University of Rome.

8.3.3. Collaborations in European Programs, except FP7

**Program:** COST
**Project acronym:** ECON@TEL
**Project title:** Econ@Tel - A Telecommunications Economics COST Network
**Duration:** October 2007 - September 2011
**Coordinator:** B. Stiller (ETH Zurich)
**Other partners:** FTW (Austria), INTEC (Belgium), CUT, UniCY (Cyprus), DTU, CBS (Denmark), Institut Telecom, Inria (France), PfH/NILC (Georgia), I-UG RUB (Germany), BME (Hungary), BRAUDE (Israel), FUB, CESPR, UniROM (Italy), RSM (The Netherlands), PUT (Poland), ASE (Romania), UniLj, CHAL, Telia (Sweden), UniLj (Slovenia), UNED, REDTEL (Spain), IC, WBC (U.K.)

**Abstract:** Bruno Tuffin is the French national delegate and project coordinator for the EU COST Activity IS0605. The goal of ECONTEL is to develop a strategic research and training network linking key individuals and organizations in order to enhance European competence in the field of telecommunications economics, to support related R&D-initiatives, and to provide guidelines and recommendations to European players (end-users, enterprises, operators, regulators, policy makers, content providers) concerning the provision to citizens and enterprises of new converged broadband and wireless content delivery networks (see [http://www.cost605.org/](http://www.cost605.org/)).

8.3.4. Major European Organizations with which you have followed Collaborations

**Partner 1:** FTW, Vienna (Austria)
We work with FTW on network economics.

**Partner 2:** NEC lab (Germany)
We work with NEC lab Germany on Machine Type Communication in LTE, and data offload in the context of Femto cell technologie.

8.4. International Initiatives

8.4.1. INRIA Associate Teams

8.4.1.1. MOCQUASIN

**Title:** Monte Carlo and Quasi-Monte Carlo for rare event simulation
INRIA principal investigator: Bruno Tuffin
International Partner:
   Institution: Université de Montréal (Canada)
   Laboratory: Département d’informatique et recherche opérationnelle
   Researcher: Pierre L’Ecuyer

Duration: 2008 - 2013
See also: http://www.irisa.fr/dionysos/pages_perso/tuffin/MOCQUASIN/

Abstract: The goal of MOCQUASIN is to design efficient Monte Carlo and quasi-Monte Carlo
simulation methods and to apply them to models in telecommunications. Simulation is indeed often
the only method to analyze complex and/or large systems, but also suffers from inefficiency. Two
specific situations on which we will focus are rare events, and revenue management. In the two
cases, we want to deal with dependent individual events or decisions, a realistic situation requiring
adapted solution techniques. The inefficiency of the standard simulation is a known issue to compute
the probability of rare event since getting it only once requires in average a long simulation time,
but most of the literature has up to now assumed independence in the models. The other framework,
revenue management in telecommunications, is the situation of providers trying to define valid offers
and capacity investments in front of complex demand models. Here too, a change in the decision of
an actor has an impact on the others that has to be taken into account.

8.4.2. ECOS project with Uruguay

- Title: Mesh wireless networks and P2P multimedia applications: tools for guaranteeing Quality of
  Experience
- INRIA principal investigator: Gerardo Rubino
- Duration: 1 2009 - 12 2011
- International Partner:
  Institution: University of the Republic, Montevideo, Uruguay
  Laboratory: Institute of Computer Science (InCo)
  Researcher: Héctor Cancela (Dean of the Faculty of Engineering, Uruguayan Responsible
  of the project)
- Abstract: The project consists in developing tools for QoS and QoE analysis of communication
  networks. We produce techniques for analyzing these structures using Monte Carlo procedures. We
  also develop tools allowing to reach specific levels in the Quality of Experience of transport structures
  for multimedia purposes, in particular when the underlying network is a mesh wireless system.

8.4.3. Visits of International Scientists

8.4.3.1. Internships

Saurabh Saxena
Subject: Video streaming in BiTorrent (P2P) networks
Institution: IIT Kanpur (India)

8.4.4. STIC Algérie

Title: Utilisation de la plate-forme de test Senslab pour le projet irrigsense
Principal investigator: Adlen Ksentini
International Partner:
Institution: Centre de Recherche sur l’information Scientifique et Technique (CERIST)
INRIA: three teams involved: Dionysos, ASAP and Cider
Laboratory: Department of Theories and Computer engineering
Researcher: Abdelouahid Derhab

Duration: 2011 - 2013

Abstract: This collaboration aims at defining new protocols for data collecting in Wireless Sensor Networks, and evaluate them with the senslab platform. After validating the proposed protocols, CERIST intends to deploy them in the context of the project (Algerian) "Sensirrig", which aims at using sensors for agricultural irrigation.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Contrat CREATE ActivDoc

Title: ActivDoc
Type: CREATE
Defi: Telecom
Duration: February 2007 - August 2011
Coordinator: Albert Benveniste
Abstract: Activedoc is funded by Région Bretagne. It started in February 2007, for 18 months, and was extended twice for 18 months. This project ended in August 2011, and funded studies on composite web services in a quantitative and qualitative way. The fundamental models studied during this project are models for Quality of Service and models for active documents. We have developed composition techniques for Web systems based on the paradigm of active documents. In particular, Activdoc funded Benoît Masson’s Post doctoral stay in Distribcom, which eventually led to the design of a distributed active document simulator.

8.1.2. Contrat CREATE Estase

Title: Estase
Type: CREATE
Defi: Lifting the applicability of formal methods to real life application.
Duration: Three years
Coordinator: Axel Legay
Others partners: None
Abstract: The main objective of the Estase project is to develop new statistical model checking algorithms. In addition, we shall study the concept of stochastic abstraction that allows to abstract the global behavior of a system by probability distribution. The results of Estase shall be implemented in the PLASMA toolset developed at INRIA Rennes.

8.2. National Initiatives

8.2.1. ANR DOTS

Participants: Claude Jard, Loïc Hélouët.

Dots (http://www.lsv.ens-cachan.fr/anr-dots/) is a national research project where Distribcom cooperates with the LSV/ENS Cachan, the LABRI/Bordeaux, the LAMSADE/Paris Dauphine and the IRCCyN/Nantes. It started in January 2007 and was originally scheduled to end in December 2010. It was extended for one additional year. The ambitious goal of the project is to consider open systems (that is interacting with other undefined systems) which are distributed and require timing information, in order to analyze concrete systems without abstracting one of these aspects. For instance, the interference between several systems require a combination of opened, distributed and timed information. Distribcom is in charge of the interaction of distributed systems with timing aspect (as timed Petri nets) or openness (as distributed controllers and distributed games).
8.2.2. ANR IMPRO

Participants: Claude Jard, Loïc Hélouët, Rouwaida Abdallah, Akshay Sundararaman.


ImpRo (http://anr-impro.irccyn.ec-nantes.fr/) is an academic research project funded by the French national research agency, within its non-thematic (“Blanc”) program. This project addresses the issues related to the practical implementation of formal models for the design of communicating embedded systems: such models abstract many complex features or limitations of the execution environment. The modeling of time, in particular, is usually ideal, with infinitely precise clocks, instantaneous tests or mode commutations, etc. Our objective is thus to study to what extent the practical implementation of these models preserves their good properties. We will first define a generic mathematical framework to reason about and measure implementability, and then study the possibility to integrate implementability constraints in the models. We will particularly focus on the combination of several sources of perturbation such as resource allocation, the distributed architecture of applications, etc. We will also study implementability through control and diagnostic techniques. We will finally apply the developed methods to a case study based on the AUTOSAR architecture, a standard of the automotive industry.

Distribcom cooperates with IRCCyN (Nantes), LIP6 (Paris), LSV (Cachan), LIAFA (Paris) and LIF (Marseille). The coordinator is Didier Lime from IRCCyN. It mainly addresses implementability of scenarios and Time Petri Nets, focusing on concurrency aspects.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. DISC

Title: Distributed supervisory control of large plants
Type: COOPERATION (ICT)
Defi: Networked embedded and control systems
Instrument: Specific Targeted Research Project (STREP)
Duration: September 2008 - December 2011
Coordinator: Univ. of Cagliari (Italy)
Others partners: Univ. of Cagliari (IT), CWI (NL), Univ. of Gent (B), Tech. Univ. Berlin (G), Univ. Zaragosa (S), Akhela (IT), CyBio (G)
See also: http://www.disc-project.eu/

Abstract: Supervisory control is a formal approach for the control of discrete event systems that aims to solve logical problems of safety, resource allocation, liveness, and fault diagnosis that can be encountered in all systems with a high degree of automation. It provides a conceptual framework for developing methods and tools for system design.

An open issue is the application of this methodology to those control problems that arise in networked embedded systems. These distributed plants are composed by several local agents that take concurrently decisions, based on information that may be local or received from neighbouring agents; they require scalable and self-organising platforms for advanced computing and control. An important feature of this type of processes is the possibility of studying them at an appropriate level of abstraction where the resulting model is a purely discrete event one. The evolution is guided by the occurrence of asynchronous events, as opposed to other real-time models where the event occurrence is time-triggered.

We plan to use several techniques to reduce the computational complexity that is one of the major obstacles to the technology transfer of supervisory control methodologies to distributed plants. These techniques are: modularity in the modelling and control design phases; coordinating control; fluidisation of some discrete-event dynamics to reduce state-space cardinality; modular state identification and modular fault detection based on the design of decentralized observers.
8.3.1.2. UniverSelf

Title: UniverSelf
Type: COOPERATION (ICT)
Defi: The Network of the Future
Instrument: Integrated Project (IP)
Duration: September 2010 - August 2013
Coordinator: Alcatel Lucent (France)
Others partners: Alcatel Lucent (F, Ir, G), NEC (G), Thales (F), Orange (F), Telecom Italia (It), Telefonica (E), Univ. College London (GB), Univ. of Surrey (GB), Univ. of Twente (NL), Univ. of Piraeus (G), Univ. of Athens (G), IBBT (B), VTT
See also: http://www.univerself-project.eu/
Abstract: UniverSelf unites 17 partners with the aim of overcoming the growing management complexity of future networking systems, and to reduce the barriers that complexity and ossification pose to further growth.
While there has been undeniable progress in the field of autonomies research over the past several years across the world and especially in Europe, widespread deployments of self-management techniques are still missing. At the same time the need for techniques enabling the transformation of operational models, the evolution of networks towards a flexible playground for operators, and more generally techniques participating to the increase of the return on investment, is becoming more and more evident. Further, most efforts and initiatives have been focussed on solving manageability bottlenecks in a given technological domain, while services extend anywhere, regardless of the technological boundaries (e.g., wireline/wireless). UniverSelf arises from this context and is thus driven by the need and objective to take self-management a leap further, and, in doing so, be both a federating and impactful project.

8.3.1.3. Danse

Type: COOPERATION (ICT)
Defi: Studying Systems of Systems (Dynamical Systems)
Instrument: Integrated Project (IP)
Duration: November 2011 - October 2014
Coordinator: Alcatel Lucent (France)
Others partners: OFFIS Institute for Information Technology (Germany), IBM Israel - Science and Technology LTD (ISRAEL), Israel Aerospace Industries (ISRAEL), Advanced Laboratory on Embedded Systems S.R.L (Italy), INRIA (France), Loughborough University (United Kingdom), EADS Innovation Works (United Kingdom), Selex Sistemi Integrati (Italy)
Abstract: Our objective is to build theory and practice for Systems of Systems (SoS). More precisely, we shall provide more important insights on SoS and understand why they must be treated differently to conventional systems.

8.3.1.4. Dali

Title: Devices for assisted Living
Type: Collaboration (ICT)
Defi: Building an automatic machine capable of assisting elderly people.
Instrument: STREP
Duration: November 2011 - October 2014
Coordinator: Trento (France)

Others partners: University of Trento (Italy), Visual Tools (Spain), Forth (Greece), Northumbria University (United Kingdom), University of Siena (Italy), INRIA (France), INDRA Software (Spain), Siemens AG Österreich (Austria)

Abstract: The objective is to build a machine that can help an elderly person to avoid obstacles. The role of INRIA is to design the algorithm that will run within the engine of the machine.

8.4. International Initiatives

8.4.1. INRIA Associate Teams

8.4.1.1. DST

Title: Distributed Supervision and time
INRIA principal investigator: Loïc Hélouët
International Partner:
  Institution: National University of Singapore (Singapore)
  Laboratory: National University of Singapore
  Researcher: Madhavan Mukund

International Partner:
  Institution: Chennai Mathematical Institute (India)
  Laboratory: Institute for Mathematical Sciences
  Researcher: P.S. Thiagarajan

International Partner:
  Institution: Institute of Mathematical Science Chennai (India)
  Laboratory: Theoretical Computer Science
  Researcher: R. Ramanujam

Duration: 2009 - 2011
See also: http://www.irisa.fr/distribcom/DST09/

This associated team is a tripartite collaboration between two projects at INRIA Rennes (S4 & Distribcom), the National University of Singapore (NUS), and two institutes in Chennai (INDIA), the Chennai Mathematical Institute (CMI) and the Institute of Mathematical Sciences (IMS). The objective of the DST project is to study distributed systems, supervision and time issues with the help of concurrency models. The two main themes of the project are supervision, and quantitative/time aspects of systems. The supervision theme focuses on distributed scheduling policies of distributed systems to ensure satisfaction of some properties (preservation of some bound on communication channels, for instance), diagnosis, and distributed control techniques. The second theme on time aspects of distributed systems focuses on the analysis of qualitative and quantitative properties of timed systems and models. The quantitative approaches rely on network calculus applied to multimode Real Time Calculus, and the timed models studied during the collaboration are time-constrained scenarios. A recent advance is DST is the elaboration of a model to describe and verify sessions in web-based systems.

8.4.1.2. FOSSA

Title: Formalizing Orchestration & Secure Services Analysis
INRIA principal investigator: Albert Benveniste

International Partner:

Institution: University of Texas Austin (United States)
Laboratory: Computer Science Department

Duration: 2010 - 2012

See also: http://www.irisa.fr/distribcom/FOSSA2010/index.htm

The widespread deployment of networked applications and adoption of the internet has fostered an environment in which many distributed services are available. There is great demand to automate business processes and workflows among organizations and individuals. Solutions to such problems require orchestration or choreography of concurrent and distributed services in the face of arbitrary delays and failures of components and communication. The Orc team, lead by Jayadev Misra at the University of Texas at Austin, has developed the Orc language to support orchestrations. The DistribCom team has developed studies regarding the Quality of Services of orchestrations and choreographies, with emphasis on Orc. The teams cooperate since 2006 and have decided to join their efforts in launching the associated team FOSSA.

The above tracks have been developed to success in 2011:

- We have come up with a comprehensive theory of QoS for service orchestrations, and more generally composite services. We believe our contract-based approach for QoS is deeply novel and we have submitted a joint paper to the IEEE Transactions on Software, which is currently under revision.
- Causality analysis of Orc programs has been completed. An efficient implementation is under development by John Thywissen (Austin) and Ajay Kattepur, Claude Jard (DistribCom). A joint publication is planned.
- The combination of orchestration languages (such as Orc) and document based workflows formalisms (such as Active XML) is of primary interest, as it offers a nice blending of declarative and functional/imperative styles of programming, for large applications. This topic has now started, under the leadership of Loïc Hélouët, with the ongoing deployment on top of Rest of a platform of servers implementing Distributed AXML.

Visits and Exchanges in 2011:

- February 25 – March 4: Ajay Kattepur has extended his stay for one more week in Austin.
- June 27 – July 1st: John Thywissen visited Rennes. Minutes of his stay are available.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. ESPAD (FEDER)

Participants: Guillaume Chelius, Sandrine Avakian, Guillaume Roche.

The ESPAD (Embedded Sport Performance Analysis Data) is bio-mechanics / physiology logging project funded by FEDER. The goal is to contribute to the design of a distributed multi-sensor architecture that can be worn by an individual and that records bio-mechanical, physiological and environmental data.

8.2. National Initiatives

8.2.1. Complex Networks Metrology (RNSC)

Participant: Christophe Crespelle.

D-NET is a member of the project Complex Networks Metrology involving LIP6 (Université Paris 6), LSIIT (Université de Strasbourg) and LIP (ENS de Lyon, Université Lyon 1). The project, funded by RNSC (Réseau National des Systèmes Complexes), started in January 2011 and ended in December 2011. Its goal is to design rigorous methods for measuring complex networks. The originality of our approach is to lead measurements dedicated to a specific property instead of trying to get a complete view of the network, which has been showed to lead to significant biases in the obtained view. Its major domain of application is Internet measurements.

8.2.2. SensLAB (ANR)

Participants: Eric Fleury [Prime Investigator], Guillaume Chelius.

The purpose of the SensLAB project is to deploy a very large scale open wireless sensor network platform. SensLAB’s main and most important goal is to offer an accurate and efficient scientific tool to help in the design, development, tuning, and experimentation of real large-scale sensor network applications. The sensLAB platform is distributed among 4 sites and is composed of 1,024 nodes. Each location hosts 256 sensor nodes with specific characteristics in order to offer a wide spectrum of possibilities and heterogeneity. The four test beds are however part of a common global testbed as several nodes will have global connectivity such that it will be possible to experiment a given application on all 1K sensors at the same time.

8.2.3. FLab (ANR)

Participants: Eric Fleury, Sandrine Avakian.

As proposed by initiatives in Europe and worldwide, enabling an open, general-purpose, and sustainable large-scale shared experimental facility will foster the emergence of the Future Internet. There is an increasing demand among researchers and production system architects to federate testbed resources from multiple autonomous organizations into a seamless/ubiquitous resource pool, thereby giving users standard interfaces for accessing the widely distributed and diverse collection of resources they need to conduct their experiments. The F-Lab project builds on a leading prototype for such a facility: the OneLab federation of testbeds. OneLab pioneered the concept of testbed federation, providing a federation model that has been proven through a durable interconnection between its flagship testbed PlanetLab Europe (PLE) and the global PlanetLab infrastructure, mutualizing over five hundred sites around the world. One key objective of F-Lab is to further develop an understanding of what it means for autonomous organizations operating heterogeneous testbeds to federate their computation, storage and network resources, including defining terminology, establishing universal design principles, and identifying candidate federation strategies. On the operational side, F-Lab will enhance OneLab with the contribution of the unique sensor network testbeds from SensLAB, and LTE based...
cellular systems. In doing so, F-Lab continues the expansion of OneLab’s capabilities through federation with an established set of heterogeneous testbeds with high international visibility and value for users, developing the federation concept in the process, and playing a major role in the federation of national and international testbeds. F-Lab will also develop tools to conduct end-to-end experiments using the OneLab facility enriched with SensLAB and LTE.

F-Lab is a unique opportunity for the French community to play a stronger role in the design of federation systems, a topic of growing interest; for the SensLAB testbed to reach an international visibility and use; and for pioneering testbeds on LTE technology.

8.2.4. SensAS (INRIA ADT)

Participants: Eric Fleury [Prime Investigator], Guillaume Chelius [scientific correspondent of the SENSBIIO work package].

The ambition of SensAS is to deploy wireless sensor and actuator applications. From the strong expertise gather in MOSAR, SensLAb and SensTOOLS, the goal is to transfer and help other INRIA research team to deploy their own application, not in the restricted networking area: flying drones, robots fleet, biologging, health, management?

8.2.5. DyVi (INRIA ARC)

Participants: Eric Fleury [Prime Investigator], Qinna Wang, Adrien Friggeri.

The goal of the ARC DyVi is to build a foundation for dynamic graph theory in order to be able to describe properties and design efficient and specific algorithmic for dynamic graph and overlapping communities. The goal is to be able to tackle multi time scale visualization tools based on TULIP, to implement data structure / handling / time scale aggregation / browsing within the TULIP software developed by the INRIA GRAVITE team. We also target epidemic process visualization in order to be able to run and "see" dynamic processes on dynamic networks.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: FP6 - LSH
Project acronym: MOSAR
Project title: Mastering hOspital Antimicrobial Resistance and its spread into the community
Duration: 2008 – 2012
Coordinator: INSERM

Other partners: University of Antwerp (Belgium), National Medicines Institute (Poland), August Pi i Sunyer biomedical research Institute (Spain), University Medical Center Utrecht (Netherlands), University of Geneva Hospitals (Swisslands), Tel Aviv Medical Center (Israel), Health Protection Agency (UK), Medical school of Paris 12 University (France), Pasteur Institute (France), Inserm-Transfert (France), Ingen Biosciences (France), BiologischeAnalyseSystemGmbH (Germany), AmpTec GmbH (Germany), Array-On GmbH (Germany)

Abstract: MOSAR is an Integrated Project supported for 5 years by the European Commission under the Life Science Health Priority of the Sixth Framework Program. Infections caused by antimicrobial-resistant bacteria (AMRB) account for an increasing proportion of healthcare-associated infections, particularly in high-risk units such as intensive care units and surgery; patients discharged to rehabilitation units often remain carriers of AMRB, contributing to their dissemination into longer-term care areas and within the community. The overall objective of MOSAR is to gain breakthrough knowledge in the dynamics of transmission of AMRB, and address highly controversial issues by testing strategies to combat the emergence and spread of antimicrobial resistance,
focusing on the major and emerging multi-drug antimicrobial resistant microorganisms in hospi-
tals, now spreading into the community. Microbial genomics and human response to carriage of
AMRB will be integrated with health sciences research, including interventional controlled studies
in diverse hospital settings, mathematical modeling of resistance dynamics, and health economics.
Results from MOSAR will inform healthcare workers and decision-makers on strategies for antici-
pating and mastering antimicrobial resistance.

8.4. International Initiatives

8.4.1. Visits of International Scientists

- Thi Ha Duong Phan, Academy of Science and Technology in Vietnam, was in visit in the D-NET
  team for one month in June 2011.
- Renaud Lambiotte, University of Namur in Belgium, was in visit in the D-NET team in November
  2011.
- Mariano Beiro, Universidad de Buenos Aires, was in visit in the DNET team for 4 months.
- Duc Thinh Nguyen, Intitut de la Francophonie pour l’Informatique in Hanoi (Vietnam), made his
  Master internship in the D-NET team for six months from March to September 2011.

8.4.2. Participation In International Programs

8.4.2.1. STIC AMSUD
Project 09STIC04, Dynamics of Layered Complex Networks, between the LNCC in Brazil (Prime Investigator
is Artur Ziviani), UFMG in Brazil, Universidad de Buenos Aires in Argentina, UPMC in France and INRIA.
The goal is to develop a better understanding of the issues involved in dealing with dynamic graphs and their
applicability to real-world complex networks. We also establish a thematic and collaborative research network
between the partners of this project involving complementary backgrounds to deal with the challenges of
investigating complex network systems.

8.4.2.2. Inria/FAPERJ
Project CoDyN (Complex Dynamic Networks) between LNCC and DNET/INRIA. The main goal of the
CoDyN project is to lay solid foundations to the characterization of dynamically evolving networks, and to the
field of dynamical processes occurring on large scale dynamic interaction networks.

8.4.2.3. PICS CNRS – Combinatorial Structures for Complex Network Modeling
Participant: Christophe Crespelle.

D-NET is a member of a PICS project of the CNRS between the Academy of Science and Technology in
Vietnam and the Laboratoire d’Informatique de Paris 6 (LIP6) and Université Claude Bernard Lyon 1 in
France. The project started on January 2010 and will end in December 2012. Its goal is to design models
of complex networks that are able to capture at the same time two of their most relevant properties: their
heterogeneous degree distribution and their high local density. The goal is to provide very general models that
do not make stronger assumptions on the structure of the graphs to be modeled. Our approach is based on
the overlapping structure of cliques in complex networks and uses mainly tools coming from combinatorics,
graph theory and statistics.
7. Partnerships and Cooperations

7.1. National Initiatives

- **AEOLUS (Mastering the Cloud Complexity)** is an ANR-ARPEGE project started on 1st December 2010 and with a 40-month duration. AEOLUS studies the problem of installation, maintenance and update of package-based software distributions in cloud-based distributed systems. The problem consists of representing the distribution and the dependencies of packages, in such a way that modification plans can be (semi)automatically synthesized when packages should be updated or the system should be reconfigured. Main persons involved: Zavattaro, Sangiorgi.

- **ETERNAL (Interactive Resource Analysis)** is an INRIA-ARC project which started on January 1st, 2011 and will end on December 31st, 2012. ETERNAL aims at putting together ideas from Implicit Computational Complexity and Interactive Theorem Proving, in order to develop new methodologies for handling quantitative properties related to program resource consumption, like execution time and space. People involved: Dal Lago, Gaboardi, Martini, Petit.

    This project has been presented during a poster session at the “journées scientifiques de l’INRIA” in Paris, November 2011.

- **S. Martini, U. Dal Lago, M. Gaboardi, and D. Sangiorgi** are involved in the CNRS PICS 2010 (“International Projects for Scientific Cooperation”) project “Linear Logic and applications.”

- **REVER (Programming Reversible Recoverable Systems)** is an ANR project starting on 1st December 2011 and with a 48-month duration. REVER aims to study the possibility of defining semantically well-founded and composable abstractions for dependable computing on the basis of a reversible programming language substrate, where reversibility means the ability to undo any distributed program execution, possibly step by step. The critical assumption behind REVER is that by adopting a reversible model of computation, and by combining it with appropriate notions of compensation and modularity, one can develop systematic and composable abstractions for recoverable and dependable systems. Main persons involved: Lanese, Laneve, Zavattaro.

7.2. European Initiatives

- **Hats (Highly Adaptable and Trustworthy Software using Formal Models)** is an EU Integrated Project from FP7, started March 2009 and with a 4 year duration. Hats studies formal methods for obtaining high adaptability combined with trustworthiness in the setting of object-oriented languages and software product lines. Most Focus members are involved.

7.3. International Initiatives

7.3.1. **INRIA International Partners**

- Department of Computer and Information Science, University of Pennsylvania. There has been several collaborations in the past. Presently M. Gaboardi is a long-term visiting researcher in the programming language group, working on resource control and programming languages.

7.3.2. **Visits of International Scientists**

    Ferret’s visit below has also been used to give a short intensive course on abstract interpretation for PhD students in Bologna.
- Matteo Cimini, Icelanding Center of Excellence in Theoretical Computer Science, Reykjavik, 1 week in December. Topic: logics for concurrent languages.
- Giorgio Delzanno, University of Genova. 2-day visit. Topic: Verification of protocols for Mobile Ad Hoc Networks.
- Claudia Faggian, PPS Paris 7, July 18-21 and October 3-7. Topic: linear logic and quantum computation
- Paolo di Giamberardino, University of Rome "La Sapienza", September 19-23. Topic: soft session types.
- Harry Mairson, Brandeis University, USA. February 4-16. Topic: the complexity of evaluation in the simply typed lambda calculus.
- Claudio Mezzina, Inria Grenoble, a few visits throughout the year, two months in total. Topic: constructs for reversible computations.

7.3.3. Other cooperations

We list here the cooperations and contacts with other groups, without repeating those already listed in previous sections.

- Inria EPI Indes, (on orchestration and programming languages). A common meeting was organised in Sophia Antipolis, May 2011, where 8 people from Focus and almost everybody from Indes participated.
  Focus and Indes have moreover significantly contributed to the “Programming language day”, May 31, 2011, Amphi Morgenstern, INRIA Sophia Antipolis – Méditerranée.
- Inria EPI Sardes (on models and languages for components, reversibility). Contact person(s) in Focus: Lanese, Sangiorgi. A number of visits in both directions. One joint PhD supervision (C. Mezzina).
- ENS Lyon (on concurrency models and resource control). Contact person(s) in Focus: Dal Lago, Gaboardi, Martini, Sangiorgi. Several visit exchanges during the year, in both directions. One joint PhD supervision (J.-M. Madiot, starting in September 2011).
- Laboratoire d’Informatique, Université Paris Nord, Villetaneuse (on implicit computational complexity). Contact person(s) in Focus: Dal Lago, Gaboardi, Martini. Several visit exchanges during the year, in both directions. An Italian PhD student (Marco Solieri) will soon start a PhD thesis with joint supervision. Gaboardi has made a 2-month visit.
- Team PPS, University of Paris-Diderot Paris 7 (on logics for processes, resource control). Contact person(s) in Focus: Dal Lago, Gaboardi, Martini, Sangiorgi, Zavattaro. Various short visits in both directions during the year.
- Research Institute for the Mathematical Sciences – RIMS – University of Kyoto, Japan (on typing and resource control). Contact person(s) in Focus: Dal Lago. A 2-week exchange (Dal Lago) in 2011.
• Computer Science Department, Brandeis University, USA (on complexity of evaluation in functional programming languages). Contact person(s) in Focus: Dal Lago, Martini. A 2-week visit exchange (Mairson) in 2011.

• Facultad de Informatica, Universidad Complutense de Madrid (on web services). Contact person(s) in Focus: Bravetti. Bravetti is an external collaborator in the Spanish Ministry of Science and Education project TESIS (advanced methodologies and tools for TESTing and web servIceS).

• EPI Carte, INRIA-Nancy Grand Est and LORIA (on implicit computational complexity). Contact person(s) in Focus: Gaboardi. A few short visits during 2011.

• Institut de Mathématiques de Luminy, Marseille (on lambda-calculi, linear logic and semantics). Contact person(s) in Focus: Dal Lago, Martini. One joint PhD supervision (Michele Alberti) is starting at the end of 2011.

• Inria EPI Signes, Inria Bordeaux Sud-Ouest (on lambda-calculi, linear logic and semantics). Contact person(s) in Focus: Dal Lago, Martini. Martini visited Signes for a few days in December 2010. One joint PhD supervision (Ivano Ciardelli).
6. Partnerships and Cooperations

6.1. Regional Initiatives

6.1.1. PEFICAMO

Participants: Hugues Fauconnier, Carole Gallet-Delporte, Julien Clément.

Managed by University Paris Diderot, H. Fauconnier is leading this project granting J. Clément from Région Ile de France.

6.2. National Initiatives

6.2.1. ANR Algorithm Design and Analysis for Implicitly and Incompletely Defined Interaction Networks (ALADDIN)

Participants: Cyril Gavoille [CNRS LABRI, University of Bordeaux, France], Dominique Fortin, Laurent Viennot, Michel Habib, Pierre Charbit, Pierre Fraigniaud.

Pierre Fraigniaud is leading an ANR project “blanc” (i.e. fundamental research) about the fundamental aspects of large interaction networks enabling massive distributed storage, efficient decentralized information retrieval, quick inter-user exchanges, and/or rapid information dissemination. The project is mostly oriented towards the design and analysis of algorithms for these (logical) networks, by taking into account proper ties inherent to the underlying infrastructures upon which they are built. The infrastructures and/or overlays considered in this project are selected from different contexts, including communication networks (from Internet to sensor networks), and societal networks (from the Web to P2P networks). Ending in November 2011, the project is prolonged until end of 2012 for LABRI partner.

6.2.2. ANR PROSE

Participants: Pierre Fraigniaud, Amos Korman, Laurent Viennot.

Managed by University Paris Diderot, P. Fraigniaud leads this project.

6.2.3. ANR Shaman

Participants: Hugues Fauconnier, Pierre Fraigniaud, Carole Gallet-Delporte, Hung Tran-The, Laurent Viennot.

Managed by University Paris Diderot, H. Fauconnier leads this project that grants Ph. D. H. Tran-The.

6.2.4. ANR Displexity

Participants: Hugues Fauconnier, Pierre Fraigniaud, Carole Gallet-Delporte, Amos Korman, Hung Tran-The, Laurent Viennot.

Managed by University Paris Diderot, C. Delporte and H. Fauconnier lead this project that grants 1 Ph. D. and 2 internships per year.
6.3. European Initiatives

6.3.1. FP7 Projet

6.3.1.1. EULER

Title: Experimental UpdateLess Evolutive Routing  
Type: COOPERATION (ICT)  
Defi: Future Internet Experimental Facility and Experimentally-driven Research  
Instrument: Specific Targeted Research Project (STREP)  
Duration: October 2010 - September 2013  
Coordinator: ALCATEL-LUCENT (Belgium)  
See also: http://www.euler-fire-project.eu/  

Abstract: EULER is a 3-year STREP Project targeting Challenge 1 “Technologies and systems architectures for the Future Internet” of the European Commission (EC) Seventh Framework Programme (FP7). The project scope and methodology position within the FIRE (Future Internet Research and experimentation) Objective ICT-2009.1.6 Part b: Future Internet experimentally-driven research. The main objective of the EULER exploratory research project is to investigate new routing paradigms so as to design, develop, and validate experimentally a distributed and dynamic routing scheme suitable for the future Internet and its evolution. The resulting routing scheme(s) is/are intended to address the fundamental limits of current stretch-1 shortest-path routing in terms of routing table scalability but also topology and policy dynamics (perform efficiently under dynamic network conditions). Therefore, this project will investigate trade-offs between routing table size (to enhance scalability), routing scheme stretch (to ensure routing quality) and communication cost (to efficiently and timely react to various failures). The driving idea of this research project is to make use of the structural and statistical properties of the Internet topology (some of which are hidden) as well as the stability and convergence properties of the Internet policy in order to specialize the design of a distributed routing scheme known to perform efficiently under dynamic network and policy conditions when these properties are met. The project will develop new models and tools to exhaustively analyse the Internet topology, to accurately and reliably measure its properties, and to precisely characterize its evolution. These models, that will better reflect the network and its policy dynamics, will be used to derive useful properties and metrics for the routing schemes and provide relevant experimental scenarios. The project will develop appropriate tools to evaluate the performance of the proposed routing schemes on large-scale topologies (order of 10k nodes). Prototype of the routing protocols as well as their functional validation and performance benchmarking on the iLAB experimental facility and/or virtual experimental facilities such as PlanetLab/OneLab will allow validating under realistic conditions the overall behaviour of the proposed routing schemes.

6.3.2. Collaborations in European Programs, except FP7

Program: EIT ICT Labs  
Project acronym: TREC-EIT-GA2011-HORS-5643  
Project title:  
Duration: 2011  
Coordinator: Ilkka Norros  
Other partners: KTH (Finland), Fraunhofer (Germany)  

Abstract: Content Distribution challenging issues; managed by TREC for France, the project allowed Pascal Felber to be invited by Fabien Mathieu for a postdoctoral position.
6.4. Teaching

Master MPRI
- Michel Habib is in charge of a course entitled “graph algorithms”.
- Pierre Fraigniaud (12 hours) is in charge of the course “Algorithmique distribuée pour les réseaux”;
- Carole Delporte and Hugues Fauconnier are in charge of “Algorithmique distribuée avec mémoire partagée”;
- Laurent Viennot (12 hours) is teaching “Structures de données distribuées et routage”

D.U.T., University of Paris Diderot
- Yacine Boufkhad (192 hours) is teaching scientific computer science and networks.

Computer Science U.F.R., University of Paris Diderot
- Fabien de Montgolfier (192 hours) is teaching foundation of computer science, algorithms, and computer architecture (192 hours);

Master 2 Computer Science, University of Marne-la-Vallée
- Fabien de Montgolfier is teaching P2P theory and application.

Professional Master, Paris Diderot University
- Michel Habib (192 hours) is in charge of two courses entitled: Search Engines; Parallelism and mobility, which includes peer-to-peer overlay networks;
- Carole Delporte (192 hours) is teaching “Distributed programming”;
- Hugues Fauconnier (192 hours) in charge of both courses “Internet Protocols and Distributed algorithms”.

Master 2 Computer Science, University of Paris 6
- Fabien Mathieu is teaching Peer-to-peer Networks (6 hours).

PhD : Mauricio Soto, "Quelques propriétés topologiques des graphes et applications à Internet et aux réseaux", Paris Diderot University, 2 December 2011, supervisors: Fabien de Montgolfier et Laurent Viennot;
PhD : Thu-Hien To: "On some graph problems in phylogenetics", Paris Diderot University, 15 September 2011, supervisor: Michel Habib;
PhD in progress : Hung Tran-The, Failure detection with Byzantine adversary, from 2010, supervisors: Hugues Fauconnier and Carole Delporte,
7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Projet “Calcul Hautes Performances et Informatique Distribuée”

Participants: Yves Caniou, Eddy Caron, Frédéric Desprez, Christian Pérez.

E. Caron leads (with C. Prudhomme from LJK, Grenoble) the “Calcul Hautes Performances et Informatique Distribuée” project of the cluster “Informatique, Signal, Logiciels Embarqués”. Together with several research laboratories from the Rhône-Alpes region, we initiate collaborations between application researchers and distributed computing experts.

7.2. National Initiatives

7.2.1. ANR White Project Rescue, 4 years, 2010-2014

Participants: Anne Benoit, Loris Marchal, Yves Robert, Frédéric Vivien, Dounia Zaidouni.

The ANR White Project RESCUE was launched in November 2010, for a duration of 48 months. It gathers three INRIA partners (Graal, Grand-Large and Hiepacs) and is led by Graal. The main objective of the project is to develop new algorithmic techniques and software tools to solve the exascale resilience problem. Solving this problem implies a departure from current approaches, and calls for yet-to-be-discovered algorithms, protocols and software tools.

This proposed research follows three main research thrusts. The first thrust deals with novel checkpoint protocols. The second thrust entails the development of novel execution models, i.e., accurate stochastic models to predict (and, in turn, optimize) the expected performance (execution time or throughput) of large-scale parallel scientific applications. In the third thrust, we will develop novel parallel algorithms for scientific numerical kernels.

7.2.2. ANR grant SPADES, 3 years, 08-ANR-SEGI-025, 2009-2012

Participants: Eddy Caron, Florent Chuffart, Frédéric Desprez, Haiwu He.

Today’s emergence of Petascale architectures and evolutions of both research grids and computational grids increase a lot the number of potential resources. However, existing infrastructures and access rules do not allow to fully take advantage of these resources. One key idea of the SPADES project is to propose a non-intrusive but highly dynamic environment able to take advantage of the available resources without disturbing their native use. In other words, the SPADES vision is to adapt the desktop grid paradigm by replacing users at the edge of the Internet by volatile resources. These volatile resources are in fact submitted via batch schedulers to reservation mechanisms which are limited in time or susceptible to preemption (best-effort mode).

One of the priorities of SPADES is to support platforms at a very large scale. Petascale environments are therefore particularly considered. Nevertheless, these next-generation architectures still suffer from a lack of expertise for an accurate and relevant use. One of the SPADES goal is to show how to take advantage of the power of such architectures. Another challenge of SPADES is to provide a software solution for a service discovery system able to face a highly dynamic platform. This system will be deployed over volatile nodes and thus must tolerate failures. SPADES will propose solutions for the management of distributed schedulers in Desktop Computing environments, coping with a co-scheduling framework.

7.2.3. ANR grant: COOP (Multi Level Cooperative Resource Management), 3 years, ANR-09-COSI-001-01, 2009-2012

Participants: Frédéric Desprez, Cristian Klein, Christian Pérez.
The main goals of this project are to set up such a cooperation as general as possible with respect to programming models and resource management systems and to develop algorithms for efficient resource selection. In particular, the project targets the SALOME platform and GRID-TLSE expert-site (http://gridtlse.org/) as an example of programming models, and Marcel/PadicoTM, DIET and XtreemOS as examples of multithread scheduler/communication manager, grid middleware and distributed operating systems.

The project is led by Christian Pérez.

7.2.4. ANR JCJC: Clouds@Home (Cloud Computing over Unreliable, Shared Resources), 4 years, ANR-09-JCJC-0056-01, 2009-2012
Participants: Gilles Fedak, Bing Tang.

Recently, a new vision of cloud computing has emerged where the complexity of an IT infrastructure is completely hidden from its users. At the same time, cloud computing platforms provide massive scalability, 99.999% reliability, and speedy performance at relatively low costs for complex applications and services. This project, lead by D. Kondo from INRIA MESCAL investigates the use of cloud computing for large-scale and demanding applications and services over unreliable resources. In particular, we target volunteered resources distributed over the Internet. In this project, G. Fedak leads the Data management task (WP3).

7.2.5. ANR ARPEGE MapReduce (Scalable data management for Map-Reduce-based data-intensive applications on cloud and hybrid infrastructures), 4 years, ANR-09-JCJC-0056-01, 2010-2013
Participants: Julien Bigot, Frédéric Desprez, Gilles Fedak, Sylvain Gault, Christian Pérez, Anthony Simonet.

MapReduce is a parallel programming paradigm successfully used by large Internet service providers to perform computations on massive amounts of data. After being strongly promoted by Google, it has also been implemented by the open source community through the Hadoop project, maintained by the Apache Foundation and supported by Yahoo! and even by Google itself. This model is currently getting more and more popular as a solution for rapid implementation of distributed data-intensive applications. The key strength of the Map-Reduce model is its inherently high degree of potential parallelism.

In this project, the GRAAL team participates to several work packages which address key issues such as efficient scheduling of several MR applications, integration using components on large infrastructures, security and dependability, MapReduce for Desktop Grid.

7.2.6. ADT MUMPS, 3 years, 2009-2012
Participants: Maurice Brémond, Guillaume Joslin, Jean-Yves L’Excellent.

ADT-MUMPS is an action of technological development funded by INRIA. Tools for experimentation, validation, and performance study of MUMPS are being developed; one of the goals was also to efficiently use and benefit from the common porting, testing and compilation cluster from INRIA, pipol.

7.2.7. ADT ALADDIN
Participants: Frédéric Desprez, Matthieu Imbert, Christian Pérez.

ALADDIN is an INRIA action of technological development for “A LArge-scale DIstributed and Deployable INfrastructure” which aim is to manage the Grid’5000 experimental platform. Frédéric Desprez is leading this project (with David Margery from Rennes as the Technical Director).

7.2.8. ADT BitDew, 2 years, 2010-2012
Participants: Gilles Fedak, José Saray.

ADT BitDew is an INRIA support action of technological development for the BitDew middleware. Objectives are several fold: i/ provide documentation and education material for end-users, ii/ improve software quality and support, iii/ develop new features allowing the management of Cloud and Grid resources. The ADT BitDew, leaded by G. Fedak, allows to recruit a young engineer for 24 months.
**7.2.9. HEMERA Large Wingspan Inria Project, 2010-2013**

**Participants:** Daniel Balouek, Christian Pérez, Frédéric Vivien.

Hemera deals with the scientific animation of the Grid’5000 community. It aims at making progress in the understanding and management of large scale infrastructure by leveraging competences distributed in various French teams. Hemera contains several scientific challenges and working groups. Christian Pérez is leading the project that involves more than 20 teams located in 9 cities of France.

C. Pérez is leading the project and D. Balouek is managing scientific challenges on Grid’5000.

**7.2.10. Action Interfaces Recherche en grille – Grilles de production. Institut des Grilles du CNRS – Action Aladdin INRIA**

**Participant:** Yves Caniou.

This action addresses economical issues concerning green-ness in scientific and production grids. Different issues are addressed like the confrontation of energy models in place in experimental grids versus the operational realities in production grids, the study of new energy prediction models related to real measures of energy consumption in production grids, and the design of energy aware scheduling heuristics.

**7.2.11. FastExpand: Regional Grant**

**Participant:** Eddy Caron.

The FastExpand start up asked to take benefit of the knowledge of the GRAAL research team on distributed systems and middleware systems. The aim of this company is to create games of new generation using a new distributed architecture. E. Caron and F. Desprez participate to this action. In 2011, a distributed prototype to work on burst requests from the MMORPG (Massively Multiplayer Online Role Playing Games) was successfully designed. The required performance has been reached.

**7.3. European Initiatives**

**7.3.1. FP7 Projects**

**7.3.1.1. BonFIRE**

- **Title:** Building service testbeds on FIRE BonFIRE
- **Type:** COOPERATION (ICT)
- **Defi:** Future Internet Experimental Facility and Experimentally-driven Research
- **Instrument:** Integrated Project (IP)
- **Duration:** June 2010 - November 2013
- **Coordinator:** ATOS Origin (Spain)
- **Others partners:** ATOS (coordinator, Spain), EPCC (UK), SAP (Germany), USTUTT (Germany), FRAUNHOFER (Germany), IBBT (Belgium), UCM (Spain), I2CAT (Spain), HP (UK), 451G (UK), TUB (Germany), IT-Innovation (UK), INRIA.
- **See also:** [http://www.bonfire-project.eu/](http://www.bonfire-project.eu/)
- **Abstract:** BonFIRE will design, build and operate a multi-site Cloud prototype FIRE facility to support research across applications, services and systems at all stages of the R&D lifecycle, targeting the services research community on Future Internet. The BonFIRE vision is to give researchers in these areas access to a facility that supports large scale multi-disciplinary experimentation of their systems and applications addressing all aspects of research across all layers. We will develop and support a framework which allows service-based computing practitioners to experiment with their latest ideas in service orientation and distributed computing. We have elaborated 3 usage scenarios. Our overall goal is to encourage new communities of experimenters to take advantage of the opportunities offered by the FIRE infrastructure to guide the development of the Future Internet from
a service-based applications standpoint. The facility will be demand-driven, open, standards-based and dynamic. It will provide additional functionality to that currently available. It will adopt the principle of “open coordinated federation of testbeds” and will provide innovative usage scenarios. We will stimulate research through 2 open calls to establish a methodology of experimentally driven research. The facility shall be open not only to the researchers selected and funded by BonFIRE through the open calls but also to a wider researcher community in order to encourage the usage and involvement of a significant number of end users.

7.3.1.2. EDGI

Title: EDGI: European Desktop Grid Initiative
Type: CAPACITIES (Infrastructures)
Instrument: Combination of COLLABORATIVE PROJECTS and COORDINATION and SUPPORT ACTIONS (CPCSA)
Duration: June 2010 - May 2012
Coordinator: MTA SZTAKI (Hungary)
Others partners: CIEMAT, ES; Fundecyt, ES; University of Westminster, UK; Cardiff University, UK; University of Coimbra, PT; CNRS, FR, AlmerGrid, NL
See also: http://edgi-project.eu/
Abstract: The project EDGI will develop middleware that consolidates the results achieved in the EDGeS project concerning the extension of Service Grids with Desktop Grids in order to support EGI and NGI user communities that are heavy users of DCIs and require extremely large number of CPUs and cores. EDGI will go beyond existing DCIs that are typically cluster Grids and supercomputer Grids, and will extend them with public and institutional Desktop Grids and Clouds. EDGI will integrate software components of ARC, gLite, Unicore, BOINC, XWHEP, 3G Bridge, and Cloud middleware such as OpenNebula and Eucalyptus into SG→DG→Cloud platforms for service provision and as a result EDGI will extend ARC, gLite and Unicore Grids with volunteer and institutional DG systems. Our partners in EDGI are : SZTAKI, INRIA, CIEMAT, Fundecyt, University of Westminster, Cardiff University, University of Coimbra. In this project, G. Fedak is the INRIA representative and lead the JRA2 work package which is responsible for providing QoS to Desktop Grids.

7.3.1.3. PRACE 2IP

Title: PRACE – Second Implementation Phase Project
Type: Integrated Infrastructure Initiative Project (I3)
Instrument: Combination of Collaborative projects and Coordination and support action
Duration: September 2011 - August 2013
Coordinator: Thomas Lippert (Germany)
Others partners: Jülich GmbH, GCS, GENCI, EPSRC, BSC, CSC, ETHZ, NCF, JKU, Vetenskapssradet, CINECA, PSNC, SIGMA, GRNET, UC-LCA, NUI Galway, UYBHIM, CaSToRC, NCSA, Technical Univ. of Ostrava, IPB, NIIF
See also: http://prace-ri.eu/
Abstract: The purpose of the PRACE RI is to provide a sustainable high-quality infrastructure for Europe that can meet the most demanding needs of European HPC user communities through the provision of user access to the most powerful HPC systems available worldwide at any given time. In tandem with access to Tier-0 systems, the PRACE-2IP project will foster the coordination between national HPC resources (Tier-1 systems) to best meet the needs of the European HPC user community. To ensure that European scientific and engineering communities have access to leading edge supercomputers in the future, the PRACE-2IP project evaluates novel architectures, technologies, systems, and software. Optimizing and scaling of application for Tier-0 and Tier-1 systems is a core service of PRACE.
7.3.2. Collaborations in European Programs, except FP7

Program: ERCIM WG
Project acronym: CoreGRID
Project title: ERCIM WG CoreGRID
Coordinator: Frédéric Desprez
Other partners: Many partners from several european countries
Abstract: Following the success of the NoE CoreGRID, an ERCIM WG was started in 2009, leaded by F. Desprez. This working group gathers 31 research teams from all over Europe working on Grids, service oriented architectures and Clouds.
A workshop on Grids, Clouds, and P2P Computing was organized in conjunction with EuroPAR 2011, Bordeaux, August, 2011.

7.4. International Initiatives

7.4.1. INRIA International Partners

Henri Casanova, Information and Computer Sciences Department, University of Hawai‘i at Mānoa: application resilience on failure-prone platforms, scheduling multiple workflows over grids.
Jack Dongarra, Computer Science Department, University of Tennessee Knoxville: linear algebra kernels for multicore and GPGPUs, exscale algorithms.
Rami Melhem, Computer Science Department, University of Pittsburgh: energy-aware scheduling algorithms.

7.4.2. Visits of International Scientists

7.4.2.1. Internship

• Lu LU, Huazong University of Science and Technology, 6 months internship

7.4.3. Participation In International Programs

7.4.3.1. INRIA-UIUC-NCSA Joint Laboratory for Petascale Computing

Participants: Julien Bigot, Mathias Jacquelin, Cristian Klein, Loris Marchal, Christian Pérez, Yves Robert, Frédéric Vivien.

The Joint Laboratory for Petascale Computing focuses on software challenges found in complex high-performance computers. The Joint Laboratory is based at the University of Illinois at Urbana-Champaign and includes researchers from the French national computer science institute called INRIA, Illinois’ Center for Extreme-Scale Computation, and the National Center for Supercomputing Applications. Much of the Joint Laboratory’s work will focus on algorithms and software that will run on Blue Waters and other petascale computers.

7.4.3.2. French-Japanese ANR-JST FP3C project

This project federates INRIA Saclay, CNRS IRIT, CEA Saclay, INRIA Bordeaux, CNRS Prism, INRIA Rennes on the French side and the University of Tokyo, The University of Tsukuba, Titech, Kyoto University on the Japanese side. The main goal of the project is to develop a programming chain and associated runtime systems which will allow scientific end-users to efficiently execute their applications on post-petascale, highly hierarchical computing platforms making use of multi-core processors and accelerators.
Y. Caniou and J.-Y. L’Excellent participate to this project.
7.4.3.3. CNRS délégation of Yves Caniou (2010-2011)

Yves Caniou obtained a CNRS delegation for the scholar year 2009-2010, and this delegation has been prolonged for the scholar year 2010-2011. He worked until 2011/09 at the CNRS Japan-French Laboratory in Informatics (JFLI) supervised by Philippe Codognet. The JFLI is located in Tokyo, Japan, and is composed of the Tokyo University, Université Pierre et Marie-Curie (UPMC), the Keio University, the CNRS, the NII partnership.

7.4.3.4. CADENCED (2009-2012)

The CADENCED project corresponds joint research activities between KAUST (King Abdullah University of Science and Technology), IFPEN (Institut Français du Pétrole Energie Nouvelle) and its partners, École Normale Supérieure de Lyon (ENS-Lyon) and National Center for Scientific Research (CNRS). ENS de Lyon is funded to a total of 1000k€ supporting 6 years of post-doc salary, 2 years of senior researchers and the afferent side-costs. The CADENCED project will address designing a new catalyst for chemistry/petrochemistry. In view of the extensive use of computing required, a challenging subproject on accelerated high performance computing (HPC) applied to catalysis is also proposed. This latest project deals with porting the VASP software to GPU and developing new QM/MM approaches.
7. Partnerships and Cooperations

7.1. Regional, National and International Actions

7.1.1. Activities starting in 2009

- Franck Cappello, Co-Director of the INRIA - Illinois Joint Laboratory on PetaScale Computing, since 2009

7.1.2. Other activities

- CALIFHA project (DIM Digiteo 2011): CALculations of Incompressible Fluid flows on Heterogeneous Architectures. Funding for a PhD student. Collaboration with LIMSI/CNRS. Participants: Marc Baboulin (Principal Investigator), Joel Falcou, Yann Fraitneau (LIMSI), Laura Grigori, Olivier Le Maître (LIMSI), Laurent Martin Witkowski (LIMSI).

- ANR SPADES Coordinated by LIP-ENS Lyon. (Sylvain Peyronnet, Franck Cappello, Ala Rezmerita)

- Défi ANR SECSI Participant to this challenge. From September 2008 to August 2010. Managed by the SAIC. (Thomas Hérault, Sylvain Peyronnet, Sébastien Tixeuil)

- ANR Cosinus project MIDAS - Microwave Data Analysis for petaScale computers December 2009 - December 2012 (http://www.apc.univ-paris7.fr/APC_CS/Recherche/Adamis/MIDAS09/index.html). Collaboration with APC, University Paris 7 and Lawrence Berkeley Laboratory. This is an interdisciplinary project devised to bring together cosmologists, computational physicists, computer scientists and applied mathematicians to face the challenge of the tremendous volume of data as anticipated from current and forthcoming Cosmic Microwave Background (CMB) experiments. (Laura Grigori, Coordinator for INRIA Saclay, F. Cappello, J. Falcou, T. Hérault, S. Peyronnet)

- ANR Cosinus project PETALh - PETascale ALgorithms for preconditioning for scientific applications January 2011- December 2012. Collaboration with Laboratoire Lions - Universite 6, IFP, INRIA Bordeaux and CEA, UC Berkeley and Argonne. The goal is to investigate preconditioning techniques on multicore architectures and apply them on real world applications from IFP, CEA and Argonne. (Laura Grigori, Principal Investigator)

- Digiteo DIM-08 project X-Scale-NL – Scheduling and numerical libraries enabling scientific applications on petascale machines 2008-2011. Funding for a Phd student and travel (114000 euros). Participants: Laura Grigori (Principal Investigator), F. Cappello (INRIA), T. Hérault, S. Peyronnet (LRI) and two foreign collaborators: J. Demmel from UC Berkeley and J. Darbon from UC Los Angeles.

- INRIA Associated Team "F-J Grid" with University of Tsukuba, head: Franck Cappello

- INRIA funding, MPI-V, collaboration with UTK, LALN and ANL, head: Franck Cappello

- ANR CIS Project FF2A3, 3 years (2007 - 2010), PI F. Hecht, subproject head L. Grigori

- HipCal, ANR CIS, 3 years (2006-2009), , Franck Cappello

7.2. International Initiatives

7.2.1. INRIA Associate Teams
• **INRIA associated team COALA with Prof. J. Demmel, UC Berkeley, 2010-2013.** This project is proposed in the context of developing Communication Optimal Algorithms for Linear Algebra. The funding covers visits in both directions. The following visits of PhD students took place in the context of this associated team:
  – Visit of A. Khabou to UC Berkeley (August 2011, for 1 month).
  – Visit of E. Carson and N. Knight from UC Berkeley to INRIA Saclay (July 2011, for 1 month).
  – Visit of S. Donfack and A. Khabou to UC Berkeley (November 2010, for 1 month).

**7.2.2. Visits of International Scientists**

• Visit of E. Carson and N. Knight from UC Berkeley (July 2011, for 1 month, July 2011).
• Visit of Gary Howell from North Carolina State University, September 2011.
8. Partnerships and Cooperations

8.1. National initiatives

8.1.1. NOSSI: New platform for parallel, hybrid quantum/classical simulations

Participants: Olivier Coulaud, Aurélien Esnard.
Grant: ANR 2007 – CIS
Partners: CPMOH (Bordeaux, UMR 5098), DRIMM, IMPREM (leader of the project, Pau, UMR 5254), Institut Néel (Grenoble, UPR2940)
Overview: Physicists, chemists and computer scientists join forces in this project to further design high performance numerical simulation of materials, by developing and deploying a new platform for parallel, hybrid quantum/classical simulations. The platform synthesizes established functions and performances of two major European codes, SIESTA and DL-POLY, with new techniques for the calculation of the excited states of materials, and a graphical user interface allowing steering, visualization and analysis of running, complex, parallel computer simulations.

The software will be capable of calculating the electronic spectra of localized excited states in solids and at interfaces. Applications of the platform include hybrid organic-inorganic materials for sustainable development, such as photovoltaic materials, bio- and environmental sensors, photocatalytic decontamination of indoor air and stable, non-toxic pigments.

Web: http://nossi.gforge.inria.fr/index.html

8.1.2. OPTIDIS: OPTimisation d’un code de dynamique des DISlocations

Participants: Olivier Coulaud, Aurélien Esnard, Luc Giraud, Jean Roman.
Grant: ANR-COSINUS
Dates: 2010 – 2014
Partners: CEA/DEN/DMN/SRMA (leader), SIMaP Grenoble INP and ICMPE / Paris-Est.
Overview: Plastic deformation is mainly accommodated by dislocations glide in the case of crystalline materials. The behaviour of a single dislocation segment is perfectly understood since 1960 and analytical formulations are available in the literature. However, to understand the behaviour of a large population of dislocations (inducing complex dislocations interactions) and its effect on plastic deformation, massive numerical computation is necessary. Since 1990, simulation codes have been developed by French researchers. Among these codes, the code TRIDIS developed by the SIMAP laboratory in Grenoble is the pioneer dynamic dislocation code. In 2007, the project called NUMODIS had been set up as team collaboration between the SIMAP and the SRMA CEA Saclay in order to develop a new dynamics dislocation code using modern computer architecture and advanced numerical methods. The objective was to overcome the numerical and physical limits of the previous code TRIDIS. The version NUMODIS 1.0 came out in December 2009, which confirms the feasibility of the project. The project OPTIDIS is initiated when the code NUMODIS is mature enough to consider parallel computation. The objective of the project in to develop and validate the algorithms in order to optimise the numerical and performance efficiencies of the NUMODIS code. We are aiming at developing a code able to tackle realistic material problems such as the interaction between dislocations and irradiation defects in a grain plastical deformation after irradiation. These kinds of studies where “local mechanisms” are correlated with macroscopic behaviour is a key issue for nuclear industry in order to understand material ageing under irradiation, and hence predict power plant secured service life. To carry out such studies, massive numerical optimisations of NUMODIS are required. They involve complex algorithms lying on advanced computational science methods. The project OPTIDIS will develop through joint collaborative studies involving researchers specialized in dynamics dislocations and in numerical methods. This project is divided in 8 tasks over 4 years. Two PhD thesis will be directly funded by the project. One will be dedicated to numerical development, validation of complex algorithms and comparison with the performance of existing dynamics dislocation codes. The objective of the second is to carry out large scale simulations to validate the performance of the numerical developments made in OPTIDIS. In both cases, these simulations will be compared with experimental data obtained by experimentalists.

8.1.3. RESCUE: RÉsilience des applications SCientifiqUEs

Participants: Emmanuel Agullo, Luc Giraud, Abdou Guermouche, Jean Roman, Mawussi Zounon.
Grant: ANR-Blanc (computer science theme)
Dates: 2010 – 2014
Partners: Inria EPI GRAAL (leader) and GRAND LARGE.
Overview: The advent of exascale machines will help solve new scientific challenges only if the resilience of large scientific applications deployed on these machines can be guaranteed. With 10,000,000 core processors, or more, the time interval between two consecutive failures is anticipated to be smaller than the typical duration of a checkpoint, i.e., the time needed to save all necessary application and system data. No actual progress can then be expected for a large-scale parallel application. Current fault-tolerant techniques and tools can no longer be used. The main objective of the RESCUE project is to develop new algorithmic techniques and software tools to solve the exascale resilience problem. Solving this problem implies a departure from current approaches, and calls for yet-to-be-discovered algorithms, protocols and software tools.

This proposed research follows three main research thrusts. The first thrust deals with novel checkpoint protocols. This thrust will include the classification of relevant fault categories and the development of a software package for fault injection into application execution at runtime. The main research activity will be the design and development of scalable and light-weight checkpoint and migration protocols, with on-the-fly storing of key data, distributed but coordinated decisions, etc. These protocols will be validated via a prototype implementation integrated with the public-domain MPICH project. The second thrust entails the development of novel execution models, i.e., accurate stochastic models to predict (and, in turn, optimize) the expected performance (execution time or throughput) of large-scale parallel scientific applications. In the third thrust, we will develop novel parallel algorithms for scientific numerical kernels. We will profile a representative set of key large-scale applications to assess their resilience characteristics (e.g., identify specific patterns to reduce checkpoint overhead). We will also analyze execution trade-offs based on the replication of crucial kernels and on decentralized ABFT (Algorithm-Based Fault Tolerant) techniques. Finally, we will develop new numerical
methods and robust algorithms that still converge in the presence of multiple failures. These algorithms will be implemented as part of a software prototype, which will be evaluated when confronted with realistic faults generated via our fault injection techniques.

We firmly believe that only the combination of these three thrusts (new checkpoint protocols, new execution models, and new parallel algorithms) can solve the exascale resilience problem. We hope to contribute to the solution of this critical problem by providing the community with new protocols, models and algorithms, as well as with a set of freely available public-domain software prototypes.

8.1.4. BOOST: Building the future Of numerical methOdS for iTer

Participants: Emmanuel Agullo, Mikko Byckling, Luc Giraud, Abdou Guermouche, Jean Roman.
Grant: ANR-Blanc (applied math theme)
Dates: 2010 – 2014
Partners: Institut de Mathématiques de Toulouse (coordinator); Laboratoire d’Analyse, Topologie, Probabilités in Marseilles; Institut de Recherche sur la Fusion Magnétique, CEAr/IRFM and Inria-HiePACS
Overview: This project regards the study and the development of a new class of numerical methods to simulate natural or laboratory plasmas and in particular magnetic fusion processes. In this context, we aim in giving a contribution, from the mathematical, physical and algorithmic point of view, to the ITER project.

The core of this project consists in the development, the analysis and the testing on real physical problems of the so-called Asymptotic-Preserving methods which allow simulations over a large range of scales with the same model and numerical method. These methods represent a breakthrough with respect to the state-of-the art. They will be developed specifically to handle the various challenges related to the simulation of the ITER plasma. In parallel with this class of methodologies, we intend to design appropriate coupling techniques between macroscopic and microscopic models for all the cases in which a net distinction between different regimes can be done. This will permit to describe different regimes in different regions of the machine with a strong gain in term of computational efficiency, without losing accuracy in the description of the problem. We will develop full 3-D solver for the asymptotic preserving fluid as well as kinetic model. The Asymptotic-Preserving (AP) numerical strategy allows us to perform numerical simulations with very large time and mesh steps and leads to impressive computational saving. These advantages will be combined with the utilization of the last generation preconditioned fast linear solvers to produce a software with very high performance for plasma simulation. For HiePACS, this project provides in particular a testbed for our expertise in parallel solution of large linear systems.

8.2. European Initiatives

8.2.1. FP7 Projet

Title: MYPLANET
Type: PEOPLE
Instrument: Initial Training Network (ITN)
Duration: October 2008 - September 2012
Coordinator: CERFACS (France)
Others partners: Allinea software, Alstom Power Switzerland, Czestochowa University of Technology, Genias Graphics, Rolls Royce PLC UK, Technical Univ. Munich, Turbomeca, University of Cambridge, University Carlos III Madrid and University of Cyprus.
See also: http://www.cerfacs.fr/myplanet/
Abstract: The present MYPLANET project responds to the first FP7-call “PEOPLE-INITIAL-TRAINING-ITN-2007-1” published by the European Commission. This collaborative initial training network represents a European initiative to train a new generation of engineers in the field of high performance computing applied to the numerical combustion simulation, energy conversion processes and related atmospheric pollution issues. Indeed, the project is based on the recognised lack on the European level of highly skilled engineers who are equally well-trained in both combustion technologies and high-performance computing (HPC) techniques. Thus the MYPLANET project will clearly contribute to the structuring of existing high-quality initial research training capacities in fluid mechanics and the HPC field through combining both public and private (industrial) sectors. The participation of industrial partners in the training of the researchers will directly expose these industries to high performance computing, which will have a very favourable impact on the quality and efficiency of their activities. Reciprocally, the research community will learn more about the mid and long term industrial challenges which will enable the research partners to initiate new activities in order to anticipate and address these industrial requirements.

8.3. International initiatives

8.3.1. Inria Associate Teams

8.3.1.1. MORSE

Title: Matrices Over Runtime Systems at Exascale
Inria principal investigator: Emmanuel Agullo
International Partner:
  Institution: University of Tennessee Knoxville (United States)
  Laboratory: Innovative Computing Lab
  Researcher: George Bosilca

International Partner:
  Institution: University of Colorado Denver (United States)
  Laboratory: Department of Mathematics and Statistical Sciences
  Researcher: Julien Langou

Duration: 2011 - 2013
See also: http://www.inria.fr/en/teams/morse.

The goal of Matrices Over Runtime Systems at Exascale (MORSE) project is to design dense and sparse linear algebra methods that achieve the fastest possible time to an accurate solution on large-scale multicore systems with GPU accelerators, using all the processing power that future high end systems can make available. To develop software that will perform well on petascale and exascale systems with thousands of nodes and millions of cores, several daunting challenges have to be overcome, both by the numerical linear algebra and the runtime system communities. By designing a research framework for describing linear algebra algorithms at a high level of abstraction, the MORSE team will enable the strong collaboration between research groups in linear algebra and runtime systems needed to develop methods and libraries that fully benefit from the potential of future large-scale machines. Our project will take a pioneering step in the effort to bridge the immense software gap that has opened up in front of the High-Performance Computing (HPC) community.

8.3.2. Visits of International Scientists

The following researchers have visited HIEPACS in 2011
• George Bosilca, University of Tennessee at Knoxville visited from June 15 to August 15.
• Ichitaro Yamazaki, from Lawrence Berkeley National Laboratory visited from August 29 to September 9.
• Hatem Ltaief, from KAUST visited from October 10 to October 14.

8.3.3. Participation in other International Programs

8.3.3.1. Scalable Hybrid Solvers for Large Sparse Linear Systems of Equations on Petascale Computing Architectures

Participants: Emmanuel Agullo, Luc Giraud, Abdou Guermouche, Jean Roman, Xavier Vasseur.

Grant: France Berkeley Fund

Dates: 2010-2012

Partners: Lawrence Berkeley National Laboratory.

Overview: Our approach to high-performance, scalable solution of large sparse linear systems in parallel scientific computing is to combine direct and iterative methods. Such a hybrid approach exploits the advantages of both direct and iterative methods. The iterative component allows us to use a small amount of memory and provides a natural way for parallelization. The direct part provides its favorable numerical properties. In the framework of this joint research action we intend to address the problems related to exploiting hybrid programming models on NUMA clusters and the solution of indefinite/augmented systems.

8.3.3.2. ECS: Enabling Climate Simulation at extreme scale

Participants: Emmanuel Agullo, Luc Giraud, Abdou Guermouche, Jean Roman, Mawussi Zounon.

Grant: G8

Dates: 2011 – 2014

Partners: Univ. Illinois at Urbanna Champaign, Inria, Univ. Tennessee at Knoxville, German Research School for Simulation Sciences, Univ. Victoria, Titech, Univ. Tsukuba, NCAR, Barcelona Supercomputing Center.

Overview: Exascale systems will allow unprecedented reduction of the uncertainties in climate change predictions via ultra-high resolution models, fewer simplifying assumptions, large climate ensembles and simulation at a scale needed to predict local effects. This is essential given the cost and consequences of inaction or wrong actions about climate change. To achieve this, we need careful co-design of future exascale systems and climate codes, to handle lower reliability, increased heterogeneity, and increased importance of locality. Our effort will initiate an international collaboration of climate and computer scientists that will identify the main roadblocks and analyze and test initial solutions for the execution of climate codes at extreme scale. This work will provide guidance to the future evolution of climate codes. We will pursue research projects to handle known roadblocks on resilience, scalability, and use of accelerators and organize international, interdisciplinary workshops to gather and disseminate information. The global nature of the climate challenge and the magnitude of the task strongly favor an international collaboration. The consortium gathers senior and early career researchers from USA, France, Germany, Spain, Japan and Canada and involves teams working on four major climate codes (CESM1, EC-EARTH, ECSM, NICAM).
8. Partnerships and Cooperations

8.1. European Initiatives

8.1.1. FP7 Project

8.1.1.1. OPNEX

Title: Optimization driven Multi-Hop Network Design and Experimentation
Type: COOPERATION (ICT)
Defi: New paradigms and experimental facilities
Instrument: Specific Targeted Research Project (STREP)
Duration: May 2008 - April 2011
Coordinator: CRTH (Greece)
Others partners: Technicolor, Freie Universitaet Berlin (FUB), Politechnika Poznanska (PUT)
See also: http://www.opnex.eu/

Abstract: OPNEX delivers a first principles approach to the design of architectures and protocols for multi-hop wireless networks. Systems and optimization theory is used as the foundation for algorithms that provably achieve full transport capacity of wireless systems. Subsequently a plan for converting the algorithms termed in abstract network models to protocols and architectures in practical wireless systems is given. Finally a validation methodology through experimental protocol evaluation in real network test-beds is proposed. OPNEX will use recent advances in system theoretic network control, including the backpressure principle, max-weight scheduling, utility optimization congestion control and primal-dual method for extracting network algorithms. These approaches exhibited already vast potential for achieving maximum capacity and full exploitation of resources in abstract network models and found their way to reality in high performance switching architectures and recent variants of TCP that embody the primal-dual optimization principle. Wireless, the fastest growing component of internet today, is also the least understood for the designer due to mobility, rapidly changing topology, radio link unpredictability and volatile load distribution among others. Current approaches used in practice for multi-hop wireless, the basic communication infrastructure for sensor network extensions of the internet, are mostly empirical and heuristic. Our system optimization approach will provide a rigorous integrated system design framework from physical up to network and transport layer that renders itself to validation and comparison with the theoretically optimal performance in terms of throughput, spectrum and energy utilization. The adopted approach on decentralization, communication and computational complexity reduction as well as autonomous operation will lead to implementable algorithms and architectures to be validated eventually in the proposed test-beds.

8.1.2. EDA project

Program: EDA (European Defense Agency
Project acronym: ETARE
Project title: ETARE
Duration: 2008-2011
Coordinator: Thales Italy
Other partners: Thales France and Belgium, Patria Aviation, Oulu university, Selex, Insta, Sapienza university and Elektrobit.

Abstract: ETARE is a project of EDA (European Defense Agency). The goal of the ETARE project is to ease the requirement to transmit more and more information and to interconnect the users in ad hoc networks. These ad hoc networks will link together the different elements on the battlefield (vehicles, foot soldiers, helicopters) and possibly connect them with naval forces. This will be possible through High Data Rate Networking waveforms, which will also insure interoperability between forces.

In this project, INRIA’s contribution is focused on network layer. INRIA studies the various protocol’s ability to handle heterogeneous ad hoc networks as well as QoS features. INRIA has delivered a draft document for this study with the following issues:

- Legacy routing protocols and geographic aware protocols,
- Overhead of routing protocols,
- General QoS architecture and application of this architecture for CSMA and TDMA protocols.

Participants: Cédric Adjih, Philippe Jacquet, Paul Mühlethaler.

8.2. International Initiatives

8.2.1. INRIA Associate Teams

8.2.1.1. RSFCI

Title: Routing in Intermittently Connected Wireless Networks
INRIA principal investigator: Philippe Jacquet
International Partner:
  Institution: Macquarie University (Australia)
  Laboratory: Department of Computing
Duration: 2009 - 2011
See also: http://hipercom.inria.fr/RSFCI/home.html

We study the problem of routing in intermittently connected wireless networks. In such networks information remains blocked in a connected component as long as the node motion allows to jump into or form a new connected component. This kind of networks are often alternatively referred as Delay/Disruption Tolerant Networks (DTN) and is the focus of many research efforts worldwide (DARPA, IETF). Our main objective is to specify efficient routing algorithms in delivery time, energy and overhead that allow to forward piece of information or packets toward a distant destination in a remote connected component currently out of reach. Our common studies range from theory to practice: we focus as well on fundamental issues such as the information propagation speed determination to the specification of a routing algorithm and protocol that approaches this theoretical performances.

8.2.2. Participation In International Programs

8.2.2.1. STIC TUNISIE

Title: Auto-adaptativity of a wireless sensor network with mobile agents : toward a green sensor network.
INRIA principal investigator: Pascale Minet
International Partner:
  Institution: ENSI (Tunisia)
Laboratory: CRISTAL
Team leader: Leila Saidane

Duration: 2009 - 2011

Abstract: This project aims to design algorithms and protocols for wireless sensors and mobile agents able to meet application requirements and provide the best performances in the considered environment. To achieve that, a cross-layering approach is considered. The network layer may use the information generated by any other higher or lower layer in the purpose of a better adaptivity to the application or the environment considered. Furthermore, since wireless sensor networks deployment is growing more and more, it is judicious to reduce their ecological impact starting with their design. This project focuses on strategies to improve energy efficiency.
8. Partnerships and Cooperations

8.1. National initiatives

8.1.1. ANR DEFIS ParTout

The PARTOUT project (PARTOUT = PARallélisme parTOUT) is funded by the ANR Défis programme for 4 years, starting January 2009. The partners of this project are the teams INDES (coordinator), CNAM/CÉDRIC, and LRI, Université d’Orsay.

8.1.2. ANR DEFIS PWD

The PWD project (for “Programmation du Web diffus”) has been funded by the ANR Défis programme for 4 years, starting November 2009. The partners of this project are the teams INDES (coordinator), LIP6 at University Pierre et Marie Curie and PPS at University Denis Diderot.

8.1.3. MEALS

The MEALS project (Mobility between Europe and Argentina applying Logics to Systems), IRSES program, started October 1st (2011), and will end September 30th, 2015. The project goals cover three aspects of formal methods: specification (of both requirement properties and system behavior), verification, and synthesis. The Indes members are involved in the task of Security and Information Flow Properties (WP3). The partners in this task include University of Buenos Aires, University of Cordoba, INRIA (together with Catuscia Palamidessi, Kostas Chatzikokolakis, Miguel Andrés) and University of Twente.

8.1.4. CIRIC

Indes participated in the proposal of the CIRIC project, a joint lab between Inria and Chile, that will start in 2012. Indes members are involved in the line: Internet Research and Development.
8. Partnerships and Cooperations

8.1. Regional Initiatives

Participant: Diana Moise.

The Brittany Regional Council provides half of the financial support for the PhD thesis of D. Moise (GRID5000BD project). This support amounts to a total of around 14,000 Euros/year. This support ended on September 30, 2011.

8.2. National Initiatives

MapReduce (2010–2014). An ANR project (ARPEGE 2010) with international partners on optimized Map-Reduce data processing on cloud platforms. This project started in October 2010 in collaboration with Argonne National Lab, the University of Illinois at Urbana Champaign, the UIUC/INRIA Joint Lab on Petascale Computing, IBM, IBCP, MEDIT and the GRAAL INRIA Project-Team. URL: http://mapreduce.inria.fr/

Grid’5000. We are members of the Grid’5000 community: we make experiments on the Grid’5000 platform on an everyday basis.

HEMERA (2010–2014). An INRIA Large Wingspan Project, started in 2010. Within Hemera, G. Antoniu (KerData INRIA Team) and Gilles Fedak (GRAAL INRIA Project-Team) co-lead the Map-Reduce scientific challenge. KerData also co-initiated a working group called “Efficient management of very large volumes of information for data-intensive applications”, co-led by G. Antoniu and Jean-Marc Pierson (IRIT, Toulouse).

EquipEx projects (submitted in 2011). We participated to the submission of two EquipEx projects in 2011: DIP-HPC in the HPC area (leader: GENCI; KerData stands for the INRIA partner); and VIRTEXP in the cloud area (leader: Christian Pérez, INRIA-GRAAL).

8.3. European Initiatives

The SCALUS FP7 Marie Curie Initial Training Network (2009–2013). Partners: Universidad Politécnica de Madrid (UPM), Barcelona Supercomputing Center, University of Paderborn, Ruprecht-Karls-Universität Heidelberg, Durham University, FORTH, École des Mines de Nantes, XLAB, CERN, NEC, Microsoft Research, Fujitsu, Sun Microsystems. Topic: scalable distributed storage. We mainly collaborate with UPM (2 co-advised PhD theses).

8.3.1. Major European Organizations with which you have followed Collaborations

CoreGRID ERCIM Working Group, since 2009. The CoreGRID Symposium held in Las Palmas de Gran Canaria, Spain, 25-26 August 2008 marked the end of the ERCIM-managed CoreGRID Network of Excellence funded by the European Commission. There, it was decided to re-launch CoreGRID as a self-sustained ERCIM Working Group covering research activities on both Grid and Service Computing while maintaining the momentum of the European collaboration on Grid research.

8.4. International Initiatives

F3PC: ANR-JST project (2010–2013). In this project we mainly collaborate with Tsukuba University, Japan (Gfarm Team). This project is a follow up to several previous collaborations: NEGST (2006–2009): CNRS-JST project. Bilateral PHC (ex-PAI) Sakura project (2006–2007).
8.4.1. INRIA Associate Teams

8.4.1.1. DataCloud@Work

Title: Distributed data management for cloud services
INRIA principal investigator: Gabriel Antoniu
International Partner:
   Institution: Politehnica University of Bucharest (UPB, Romania)
   Laboratory: Distributed Systems Software Laboratory, National Center for Information Technology (NCIT, http://cs.pub.ro/)
   Researcher: Valentin Cristea, Professor at UPB

Duration: 2010–2012
See also: http://www.irisa.fr/kerdata/doku.php?id=cloud_at_work:start

Our research topics address the area of distributed data management for cloud services. We aim at investigating several open issues related to autonomic storage in the context of cloud services. The goal is to explore how to build an efficient, secure and reliable storage IaaS for data-intensive distributed applications running in cloud environments by enabling an autonomic behavior, while leveraging the advantages of the grid operating system approach.

Our research activities involve the design and implementation of experimental prototypes based on the following software platforms:
   - The BlobSeer data-sharing platform (designed by the KerData Team)
   - The XtreemOS grid operation system (designed under the leadership of the Myriads Team)
   - The MonALISA monitoring framework (using the expertise of the PUB Team).

8.4.2. Visits of International Scientists

Bunjamin Memishi, Visiting PhD student Universidad Politecnica de Madrid (UPM), 1 month (April 2011), funded by Universidad Politecnica de Madrid through the SCALUS Marie-Curie Initial Training Network. His thesis is co-advised by Mariá Pérez (UPM) and Gabriel Antoniu (KerData).

Florin Pop, Visiting Postdoc Fellow Polytechnic University of Bucharest, 1 month (June 2011), funded by the DataCloud@work Associate Team.

Ciprian Dobre, Visiting Postdoc Fellow Polytechnic University of Bucharest, 1 month (June 2011), funded by the DataCloud@work Associate Team.

Elena Apostol, Visiting PhD student Polytechnic University of Bucharest, 3 months (June - August 2011), funded by the DataCloud@work Associate Team.

Daniel Higuero, Visiting PhD student Carlos III University, Madrid, 3 months (September-November 2011), funded by Carlos III University, Madrid.

8.4.3. Participation In International Programs

Joint INRIA-UIUC Lab for Petascale Computing (JLPC), since 2009. Collaboration on concurrency-optimized I/O for post-Petascale platforms (see details in Section 4.1). A joint project proposal with the team of Rob Ross (Argonne National Lab) has been submitted in 2011 to the FACCTS call for projects (evaluation pending).
8. Partnerships and Cooperations

8.1. Regional Initiatives

The TEAM is involved in several actions of the regional CPER (Contrat Plan Etat Region) initiative on networked security as well as in the security of industrial networked systems initiative. We are also involved in the smart living initiative of the CPER where we provide our expertise on embedded operating systems and sensors.

8.2. National Initiatives

The team is participating in several national research projects: ANR MAPE and coordinator of the ANR VAMPIRE project. In addition the team is involved in one P2P project with the University of Troyes (GIS 3S).

8.3. European Initiatives

8.3.1. Think tanks and european institutes

Olivier Festor is member of the Future Media Internet think tank at the European Commission, part of the European Future Internet Assembly. In 2011, the think tank did contribute to the FIA events and issue one white paper on the Future Media Internet Architecture [37].

Since November 1st 2011, Olivier Festor is the Director of Research of the European Institute of Innovation and Technology EIT ICT Labs.

8.3.2. Academics cooperations

MADYNES has an ongoing collaboration with the university of Luxembourg on network security. Two joint thesis are part of this collaboration: the thesis of Gerard Wagener on high interaction honeypot models and the thesis of Sheila Becker on game theory-based protocol fuzzing.

We are also members of the EUNICE consortium. EUNICE has been established to foster the mobility of students, faculty members and research scientists working in the field of information and communication technologies and to promote educational and research cooperations between its member institutions. The major event of EUNICE is an annual summer school which brings together lecturers, researchers, students and people from the industry across Europe for one week of presentations, discussions and networking. Isabelle Chrismont is member of EUNICE technical committee.

8.3.3. FP7 Projects

8.3.3.1. Universef

Title: Universef
Type: COOPERATION (ICT)
Defi: The Network of the Future
Instrument: Integrated Project (IP)
Duration: September 2010 - August 2013
Coordinator: Alcatel Lucent Bellabs (France)
Others partners: Alcatel-Lucent Bell Labs (France), Alcatel Lucent Ireland Limited (Ireland), Alcatel-Lucent Deutschland AG (Germany), NEC Europe Ltd. (Germany), Thales Communications SA (France), France Telecom SA (France), Telecom Italia S.p.A (Italy), Telefonica Investigacion y Desarrollo (Spain), Fraunhofer-Gesellschaft Zur Foerderung Der Angewandten Forschung E.V (Germany), Interdisciplinary Institute for Broadband Technology (Belgium), Inria (France), VTT Technical Research Centre of Finland (Finland), University College London (UK), University of Surrey (UK), National and Kapodistrian University of Athens (Greece), University of Piraeus Research Centre (Greece), Universiteit Twente (The Netherlands)

See also: www.univerself-project.eu/

Abstract: This FP7 European integrated project aims at consolidating the autonomic methods and techniques supporting the management of the future Internet, and at integrating these methods into a unified management framework. The objective of this framework is to address the management issues of the evolving Internet through the self-organisation of the control plane and the empowerment of the management plane with cognition.

Our work in the Universef project mainly concerns the security and safety challenges posed by the unified management framework, in particular the prevention of configuration vulnerabilities.

8.3.3.2. FI-WARE

Title: Future Internet Core Platform
Type: COOPERATION (ICT)
Defi: PPP FI: Technology Foundation: Future Internet Core Platform
Instrument: Integrated Project (IP)
Duration: May 2011 - April 2014
Coordinator: Telefonica (Spain)

Others partners: Telefonica I+D (Spain), SAP AG (Germany), IBM, Thales (France), Telecom Italia (Italy), Orange Labs - France Telecom (France), Nokia Siemens Networks (Germany), Deutsche Telekom (Germany), Technicolor (France), Ericsson (Sweden), ATOS ORIGIN S.A.E (Space), Engineering Ingegneria Informatica S.p.A (Italy), Alcatel-Lucent Deutschland AG (Germany), Alcatel-Lucent Italia S.p.A (Italy), Siemens AG (Germany), Intel (Ireland), NEC Europe Ltd. (Germany), Fraunhofer Institute for Open Communication Systems FOKUS (Germany), Inria (France), Universidad Politecnica de Madrid (Spain), University of Duisburg-Essen (Germany), University of Rome - Sapienza (Italy), University of Surrey (UK),

See also: http://www.fi-ware.eu/

Abstract: The goal of the FI-WARE project is to advance the global competitiveness of the EU economy by introducing an innovative infrastructure for cost-effective creation and delivery of services, providing high QoS and security guarantees. FI-WARE is designed to meet the demands of key market stakeholders across many different sectors, e.g., healthcare, telecommunications, and environmental services. The project unites major European industrial actors in an unique effort never seen before.

The key deliverables of FI-WARE will deliver an open architecture and implementation of a novel service infrastructure, building upon generic and reusable building blocks developed in earlier research projects. This infrastructure will support emerging Future Internet (FI)services in multiple Usage Areas, and will exhibit significant and quantifiable improvements in the productivity, reliability and cost of service development and delivery - building a true foundation for the Future Internet.

The MADYNES contributions to the FI-WARE project are:

- a fuzzing framework for the Internet of Things part dimension of the FI-WARE platform. More specifically we will instantiate the KIF framework to a SCADA case study;
- a smartphone level flow monitoring appliance;
- integration facility of OVAL specifications into the FI-WARE ecosystem.
8.3.3.3. SCAMSTOP

Title: SCAMSTOP
Type: CAPACITIES (Research for SMEs)
Instrument: Research for the Benefit of SMEs (SME)
Duration: January 2010 - December 2011
Coordinator: Fraunhofer Institute for Open communication Systems FhG Fokus (Germany)
Others partners: TEI of Mesolonghi (Greece), Inria (France), Telio (Norway), Voz Telecom (Spain), PDM & FC (Portugal)
See also: http://www.sme-scamstop.eu/

Abstract: SCAMSTOP will provide a complete framework/solution for automatic fraud detection that alarms providers when suspicious behaviour is detected. Thereby, SCAMTOP will make fraud detection not only simpler but much faster as well. The developed tools can be used by VoIP/ISP providers to protect their services against losses due to fraud and to identify previously uncollected revenue sources.

We do contribute to this project by the design and implementation of fraud detection mechanisms based on advanced clustering techniques.

8.4. International Initiatives

We actively participate to the Internet Research Task Force (IRTF) Network Management Research Group (NMRG). Since March 1st 2011, Olivier Festor was named co-chair of this research group within IRTF. The group did organize one meeting in Quebec in July 2011. A workshop on flow-level management will be held in conjunction with the next IETF (March 2012) in Paris.

8.4.1. INRIA International Partners

We have established a strong cooperation with the team of Thomas Djotio at the Polytechnical Superior National School (PSNS) of the Yaoundé University. We currently have two joint Ph.D. students and regular exchanges of researchers.

8.4.2. Visits of International Scientists

8.4.2.1. Invited researchers and professors

Ramin Sadre from University of Twente, spent 3 weeks in the team, working on anomaly detection based on flow analysis.

Pr Priyadarsri Nanda from the University of Technology, Sydney Australia spent 6 months on the team working on new naming schemes and advanced routing on wireless sensor networks.

8.4.2.2. Internships

Balkiss Souissi (from Feb 2011 until Aug 2011)
Subject: A self-monitoring approach for RPL-enabled wireless sensor networks
Institution: Ecole Nationale d’Ingénieurs de Tunis (ENIT) (Tunisia)

Cesar Bernardini (from Mar 2011 until Oct 2011)
Subject: An Offensive Security Tool for 6lowpan Networks
Institution: Universidad Nacional de Cordoba (Argentina)

Bilel Saadallah (from Mar 2011 until Aug 2011)
Subject: Passive Monitoring of 802.15.4/6LowPan-enabled Wireless Sensor Networks
Institution: Ecole Nationale des Sciences de l’Informatique (Tunisia)

Lucia Masola
Subject: Collaborative Sharing of Vulnerability Descriptions in Autonomic Networks
Institution: Universidad Nacional del Centro de la Provincia de Buenos Aires (Argentina)

Francois Despaux
Subject: Highly Modular SIP Honeypot
Institution: Universidad de la Republica (Uruguay)

Damian Vicino
Subject: Design and Implementation of a Multi-Protocol Peer-to-Peer Client
Institution: Universidad de Buenos Aires (Argentina)

Prabhjot Prabhjot Singh
Subject: NETCONF Friendly Firewall Configuration Models
Institution: IIT Bombay (India)

Imen Mahjri (from Mar 2011 until Aug 2011)
Subject: Exploring cognitive techniques for sensor networks management
Institution: Ecole Nationale des Sciences de l’Informatique (Tunisia)
7. Partnerships and Cooperations

7.1. International Initiatives

7.1.1. INRIA International Partners

7.1.1.1. St. Petersburg State University

Participant: Konstantin Avrachenkov.

MAESTRO has a continuing collaboration with St. Petersburg State University. St. Petersburg State University is a partner in INRIA Internship International programme. In particular, MAESTRO hosts every year several intern students from St. Petersburg State University. The collaboration with L. Petrosyan and A. Garnaev is on the application of game theory to resource allocation in networks. The collaboration with V. Dobrynin is on data clustering.

7.1.2. Visits of International Scientists

7.1.2.1. Professors

- Augustin Chaintreau (from November 4, 2011 until November 9, 2011)
  Institution: Columbia University, New York (USA)
- Andrey Garnaev (from May 8, 2011 until May 13, 2011)
  Institution: St. Petersburg State University (Russian Federation)
- Richard Gibbens (from April 4, 2011 until April 10, 2011)
  Institution: University of Cambridge (United Kingdom)
  Institution: Russian Academy of Sciences (Russian Federation)
- Charles Pearce (from September 25, 2011 until September 30, 2011)
  Institution: University of Adelaide (Australia)
- Karl Sigman (from March 25, 2011 until March 26, 2011)
  Institution: Columbia University, New York (USA)
- Don Towsley (from March 28, 2011 until June 27, 2011)
  Institution: University of Massachusetts at Amherst (USA)
- Uri Yechiali (from March 27, 2011 until April 4, 2011)
  Institution: Tel Aviv University (Israel)

7.1.2.2. Post-doctoral fellows

- Josu Doncel (from July 9, 2011 until July 16, 2011)
  Subject: Multiarmed Bandit Problems
  Institution: Basque Center for Applied Mathematics (BCAM), Derio (Spain)
Nicolas Gast (from October 23, 2011 until October 25, 2011)
Institution: École Polytechnique Fédérale de Lausanne (Switzerland)

Jasper Goseling (from November 14, 2011 until November 18, 2011)
Institution: University of Twente (The Netherlands)

Peter Jacko (from July 9, 2011 until July 16, 2011)
Subject: Multiarmed Bandit Problems
Institution: Basque Center for Applied Mathematics (BCAM), Derio (Spain)

7.1.2.3. Ph.D. students
Eugenio Martin Della Vecchia (from July 11, 2011 until July 19, 2011)
Subject: Rolling Horizon stochastic control
Institution: National University of Rosario (Argentina)

Ana Maria Galindo (from September 15, 2011 until December 15, 2011)
Institution: Centre Tecnològic de Telecomunicacions de Catalunya (CTTC) (Spain)

Naveen K. P. (from October 11, 2011 until October 20, 2011)
Subject: Self Organization in Wireless Networks
Institution: Indian Institute of Science, Bangalore (India)

Sulan Wong (from May 2, 2010 until July 31, 2011)
Subject: Intellectual property and human rights : Patent law interference in the exercise of the scientific research freedom, the right to life and the right to health
Institution: University of A Coruña (Spain)

7.1.2.4. Graduate students
Tejas Bodas (from October 17, 2011 until October 20, 2011)
Institution: Indian Institute of Technology Bombay (India)

7.1.2.5. Internships
Adam Abeshouse (from June 1, 2011 until July 21, 2011)
Subject: Simulator for visualization of evolutionary games
Institution: Brown University (USA)

Bogdan Augustin Benga (from April 1, 2011 until September 30, 2011)
Subject: Monte Carlo Methods for Centrality Measures in Online Social Networks
Institution: West Timisoara University (Romania)

John Boreiko (from June 1, 2011 until July 21, 2011)
Subject: Simulator for visualization of replicator dynamics in evolutionary games
Institution: Brown University (USA)

Vladimir Fux (from March 17, 2011 until June 15, 2011)
Subject: Framework for crawling and analyzing web and social networking graphs  
Institution: St. Petersburg State University (Russia (Russian Federation))

Alexey Mishenin (from February 23, 2011 until March 25, 2011)
Subject: Random walks based clustering techniques  
Institution: St. Petersburg State University (Russia (Russian Federation))

Harshil Mittal (from May 30, 2011 until August 26, 2011)
Subject: Study of network capacity sharing in contents distribution networks  
Institution: LNM Institute of Information Technology (India)

Larissa Spinelli (from April 18, 2011 until July 15, 2011)
Subject: Consensus algorithms in complex networks  
Institution: Universidade Federal do Rio de Janeiro (Brazil)

7.1.3. Participation in International Programs

7.1.3.1. STIC Tunisie

Participants: Eitan Altman, Majed Haddad.

E. Altman and M. Haddad have been collaborating with I. Mabrouki (Institut Supérieur d’Informatique et des Techniques de Communication, Tunisia) on intelligent jamming in wireless networks, i.e. jamming in which the jammer is aware of the protocol used by the network.

7.1.3.2. Indo-French Centre for the Promotion of Advanced Research (IFCPAR)

Participants: Eitan Altman, Manjesh Kumar Hanawal.

Within project 4000-IT on “Emerging Strategies for Wireless Communication Networks,” E. Altman and M. K. Hanawal (also with Univ. Avignon/LIA) have been collaborating with V. Kavitha (Univ. Avignon/LIA), R. Sundaresan and C. Singh (Indian Institute of Science, India) on evaluating and optimization issues in wireless networks. They also worked on network neutrality issues.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. ECODE

Participant: Konstantin Avrachenkov.

Title: Experimental COgnitive Distributed Engine (ECODE)
Type: COOPERATION (ICT)
Challenge: New paradigms and experimental facilities
Instrument: Specific Targeted Research Project (STREP)
Duration: September 2008 – August 2011
Coordinator: Alcatel Lucent (Belgium)

Other partners:
- Universite Catholique de Louvain (UCL), IP Networking Lab (INL) (Belgium)
- Universite de Liege (ULg), Research Unit in Networking (Belgium)
- Interdisciplinair instituut voor BreedBand Technologie (IBBT), iLab.t (Belgium)
- Lancaster University (ULANC), Computing Department (United Kingdom)
• Centre National de la Recherche Scientifique (CNRS), Laboratory for Analysis and Architecture of Systems (LAAS) (France)

See also: http://www.ecode-project.eu/

Abstract: As part of the Future Internet Research and Experimentation (FIRE) initiative, the ECODE FP7 project designs and experiments machine learning-based control functionality. For this purpose, the project designs, develops, and experiments a distributed machine learning component that augments the capability and functionality of the routing and the forwarding engine of current routers. To evaluate the executability and the performance of the developed machine learning based control functionality, several experiments are conducted at the iLab.t experimental facility, located at iBBT in Ghent, Belgium.

MAESTRO’s task is to design and evaluate flow management schemes that can deal with potentially sampled traffic information. K. Avrachenkov is the coordinator for MAESTRO.

7.3. National Initiatives

7.3.1. ANR Verso ECOSCELLS (11/2009–10/2012)
Participants: Eitan Altman, Konstantin Avrachenkov, Philippe Nain.

ANR Verso ECOSCELLS (Efficient Cooperating Small Cells) aims at developing algorithms and solutions which will be required for the deployment of small cell networks. The theoretical studies will define and solve the models needed to understand the behavior of radio channels, and will design the algorithms which will allow the exploitation of the diversity (user, spatial, interference, etc.) in these networks. The consortium gathers two main industrial groups in the telecommunication domain (ALCATEL-LUCENT BELL LABS (leader) and Orange Labs), together with three leading SMEs (3ROAM, SEQUANS and SIRADEL) and six academic partners (University of Avignon, INRIA through its project-teams MAESTRO, MASCOTTE and SWING, INSTITUT EURECOM, LAAS-CNRS and Laboratoire des Signaux et Systèmes/SUPELEC).

http://perso.citi.insa-lyon.fr/hrivano/contrats/ecoscells.php

7.3.2. ANR Syscom MODECOL (01/2009–12/2011)
Participants: Eitan Altman, Alain Jean-Marie.

ANR Syscom MODECOL (Using mathematical MODeling to improve ECOlogical services of prairial ecosystems) is integrated in the framework of the urgent need for solutions for compensating human deterioration of the environment. New environmental policies point out natural ecosystems as key elements for providing ecological services such as water purification, soil detoxification, climate regulation and advocate for the creation of new ecosystems (as surrogates for the degraded natural systems) for increasing their positive effect on the environment. The design of such new ecosystems needs to be optimized for providing the best ecological services. The project MODECOL aims at developing a hybrid model, sufficiently realistic, that will simulate a prairial ecosystem (modelled through IBM) correlated through feedbacks to environmental conditions (modelled through PDEs). This approach aims to provide a virtual laboratory for testing ecological hypothesis on complex ecological systems.

The participants are: UMR Ecobio (CNRS/Univ. Rennes 1), University of Houston (USA), University of Berkeley (USA), University of La Rochelle, and INRIA through its projects and project-teams MAESTRO, MODEMIC and TOSCA.


7.3.3. ANR Multimedia VOODDO (2008-2011)
Participant: Alain Jean-Marie.
The aim of this research project, now terminated, was the development of an innovative visualization interface for video contents, based on a safe, reliable and optimized storage and transport infrastructure. It was coordinated by the VodDnet company, and involved researchers of the LIRMM (University of Montpellier 2 and CNRS). The last results obtained were on the optimal placement of data [84] and the problem of prefetching data so that users never experience blocking [86].

7.3.4. INRIA Cooperative Research Initiative (ARC) OCOQS (2011-2013)

Participant: Alain Jean-Marie.

The ARCOCOQS (Optimal threshold policies in COntrolled Queuing Systems) is devoted to the structural analysis of Markov Decision Processes, with the objective to improve the set of formal techniques available to prove that optimal control policies have a particular structure (typically, threshold-type). One of the benchmarks for this project is the extension of the model solved in [102]. This project also involves A. Busic (INRIA project-team TREC), E. Hyon (LIP6 and Univ. Paris 10) and I. Vliegen (Univ. Twente).

http://www.di.ens.fr/~busic/OCOQS/

7.4. Visits of Maestro staff to other research institutions

K. Avrachenkov visited the Basque Center for Applied Mathematics (BCAM) (Derio, Spain) in the period January 10–15, 2011, the University of Liverpool (United Kingdom) in the period March 7–11, 2011, and the University of Twente in the period May 23, 2011 – June 24, 2011.

A. Jean-Marie visited the Groupe d'études et de recherche en analyse des décisions (GERAD) (Montréal, Canada), in the periods May 2–27, 2011, and November 21–30, 2011, as well as the Universidad Nacional de Rosario (Rosario, Argentina), in the period September 3–7, 2011.

G. Neglia visited the Electrical Engineering Department of the University of Palermo (Italy), in the period December 22–23, 2011.
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR Jeunes Chercheurs DIMAGREEN, 09/2009-08/2012

Participants: David Coudert, Frédéric Giroire, Alvinice Kodjo, Dorian Mazaucric, Joanna Moulierac, Truong Khoa Phan, Issam Tahiri.

The objectives of the project DIMAGREEN (DesIgn and MAnagement of GREEN networks with low power consumption) are to introduce and analyze energy-aware network designs and managements in order to increase the life-span of telecommunication hardware and to reduce the energy consumption together with the electricity bill.

(http://www-sop.inria.fr/teams/mascotte/Contrats/DIMAGREEN/index.php)

8.1.2. ANR Blanc AGAPE, 10/2009-09/2013


The project AGAPE (Parameterized and exact graph algorithms) is led by MASCOTTE and implies also LIRMM (Montpellier) and LIFO (Orléans). The aim of AGAPE is to develop new techniques to solve exactly NP-hard problems on graphs. To do so, we envisage two approaches which are closely related ways to reduce the combinatorial explosion of NP-hard problems: moderately exponential exact algorithms and fixed-parameter tractability.

(http://www-sop.inria.fr/mascotte/Contrats/Agape.php)

8.1.3. ANR VERSO ECOSCells, 11/2009-12/2012

Participants: David Coudert, Issam Tahiri.

The ECOSCells (Efficient Cooperating Small Cells) project aims at developing the algorithms and solutions required to allow Small Cells Network (SCN) deployment. The consortium gathers industrial groups, together with 3 SMEs and 6 research institutes: ALCAETEL-LUCENT BELL LABS (leader), ORANGE LABS, 3-ROAM, SEQUANS, SIRADEL, INRIA teams MAESTRO, MASCOTTE and SWING, Université d’Avignon et des Pays de Vaucluse, Laboratoire des Signaux et Systèmes / Supelec, LAAS and Eurecom.

(http://perso.citi.insa-lyon.fr/hrivano/contrats/ecoscells.php)

8.1.4. ANR USS-SimGrid, 12/2008-12/2011

Participants: Olivier Dalle, Emilio Mancini.

The USS-SimGrid project aims at Ultra Scalable Simulations with SimGrid. This tool is leader in the simulation of HPC settings, and the main goal of this project is to allow its use in the simulation of desktop grids and peer-to-peer settings.

(http://uss-simgrid.gforge.inria.fr/)

8.1.5. Action ResCom, ongoing (since 2006)

Réseaux de communications, working group of GDR ASR, CNRS. (http://citi.insa-lyon.fr/rescom/)

8.1.6. Action Graphes, ongoing (since 2006)

Action Graphes, working group of GDR IM, CNRS. (http://www.labri.fr/perso/raspaud/pmwiki/pmwiki.php)
8.2. European Initiatives

8.2.1. FP7 Projet

8.2.1.1. EULER  
**Participants:** David Coudert, Aurélien Lancin, Nicolas Nisse, Bi Li.  
Title: EULER (Experimental UpdateLess Evolutive Routing)  
Type: COOPERATION (ICT)  
Challenge: Future Internet Experimental Facility and Experimentally-driven Research  
Instrument: Specific Targeted Research Project (STREP)  
Duration: October 2010 - September 2013  
Coordinator: ALCATEL-LUCENT (Belgium)  
Others partners: IBBT (Belgium), UPMC (France), UCL (Belgium), RACTI (Greece), CAT (Spain)  
See also: [http://www.euler-fire-project.eu/](http://www.euler-fire-project.eu/)  
Abstract: STREP EULER (Experimental UpdateLess Evolutive Routing) is part of FIRE (Future Internet Research and Experimentation) objective of FP7. It aims at finding new paradigms to design, develop, and validate experimentally a distributed and dynamic routing scheme suitable for the future Internet and its evolution. The STREP EULER gathers 7 partners: Alcatel-Lucent Bell (leader) (Antwerp, Belgique), IBBT (Ghent, Belgium), UCL (Louvain, Belgium), RACTI (Pátrás, Greece), UPC (Barcelona, Spain), UPMC (ComplexNetworks, Paris 6), INRIA (MASCOTTE, GANG, CEPAGE). MASCOTTE is the leader of WP3 on Topology Modelling and Routing scheme experimental analysis.

8.2.2. Collaborations in European Programs, except FP7

8.2.2.1. PICS CNRS (with Charles University, Prague), 01/2009-12/2012  
**Participants:** Nathann Cohen, Frédéric Havet, František Kardoš, Leonardo Sampaio.  
On Graph coloring: theoretical and algorithmic aspects.

8.2.2.2. PHC PROCOPE (with Discrete Optimization group of RWTH Aachen University), 01/2011-12/2012  
**Participants:** Christelle Caillouet, David Coudert, Alvinice Kodjo, Issam Tahiri.  
"Défis algorithmiques dans les réseaux de communication". The purpose of the project is to exchange expertise between the discrete optimization group of RWTH Aachen University and the MASCOTTE team at INRIA Sophia-Antipolis and to address algorithmic problems in communication networks.

8.3. International Initiatives

8.3.1. INRIA Associate Teams

8.3.1.1. DISSIMINET  
**Participants:** Olivier Dalle, Emilio Mancini, Van Dan Nguyen.  
Title: Web-Service approaches for simulation  
INRIA principal investigator: Olivier Dalle  
International Partner:  
Institution: Carleton University (Canada)  
Laboratory: Advanced Real-Time Simulation Laboratory  
Duration: 2011 - 2014
This Franco-Canadian team will advance research on the definition of new algorithms and techniques for component-based simulation using a web-services based approach. On the one hand, the use of web-services is expected to solve the critical issues that pave the way toward the simulation of systems of unprecedented complexity, especially (but not exclusively) in the studies involving large networks such as Peer-to-peer networks. Web-Service-oriented approaches have numerous advantages, such as allowing the reuse of existing simulators, allowing non-computer experts to merge their respective knowledge, or seamless integration of complementary services (eg. on-line storage and repositories, weather forecast, traffic, etc.). One important expected outcome of such approaches is to improve significantly the simulation methodology in network studies, especially by enforcing the seamless reproducibility and traceability of simulation results. On the other hand, a net-centric approach of simulation based on web-services comes at the cost of added complexity and incurs new practices, both at the technical and methodological levels. The results of this common research will be integrated into the discrete-event distributed simulators of both teams: the CD++ simulator at Carleton University and the simulation middle-ware developed in the MASCOTTE EPI, called OSA, whose developments are supported by an INRIA ADT since January 2011.

8.3.1.2. EWIN

**Participants:** Julio Araújo, Frédéric Giroire, Frédéric Havet, Ana Karolinna Maia, Nicolas Nisse, Ronan Pardo Soares, Leonardo Sampaio.

**Title:** Efficient algorithms in WIreless Networks

**INRIA principal investigator:** Frédéric Havet

**International Partner:**

- **Institution:** Universidade Federal do Ceara (Brazil)
- **Laboratory:** Laboratorio de Inteligencia Artificial

**Duration:** 2009 - 2011

See also: [http://www-sop.inria.fr/teams/mascotte/equipeassociee/ewin/](http://www-sop.inria.fr/teams/mascotte/equipeassociee/ewin/)

The research themes are the design of exact or approximate algorithms for solving problems in networks, in particular wireless networks. The problems that we will consider can be modelled as graph coloring or graph decomposition problems. More specifically, we studied the following problems: channel assignment in radio networks which can be modelled by various graph coloring problems, dynamic routing in wireless networks using microwave links, and routing reconfiguration in MPLS or WDM networks, certain models of which are closely related to graph searching problems and tree and path decompositions.

8.3.1.3. ANR International Taiwan GRATEL, 01/2010 – 12/2013

**Participants:** Jean-Claude Bermond, Nathann Cohen, Frédéric Havet, František Kardoš, Leonardo Sampaio.

GRATEL (Graphs and Telecomunications) has been started in collaboration with LABRI Bordeaux, UJF Grenoble and three partners in Taiwan: Sun Yat-sen University, the National Taiwan University and Academia Sinica. ([https://gratel.labri.fr/pmwiki.php?n=Main.HomePage](https://gratel.labri.fr/pmwiki.php?n=Main.HomePage))

8.3.2. INRIA International Partners

- **Montreal, Canada:** Collaboration and joint publications with B. Jaumard (Concordia), B. Reed (Mac Gill).
- **Vancouver, Canada:** Visits of J. Yu and J. Peters (SFU Vancouver, Canada) in Mascotte and joint publications.
Santiago, Chile: Reciprocal visits of N. Nisse in Chile and I. Rapaport (Universidad de Chile) and K. Suchan (Universidad Adolfo Ibáñez) in Mascotte. Moreover, there are joint publications.

Odensee, Denmark: Visits of J. Bang-Jensen (University of Southern Denmark). N. Nepomuceno (former PhD in Mascotte) went to University of Southern Denmark for his Post-Doc. Moreover, there are joint publications.

Patras, Greece: Long-term collaboration with University of Patras, D. Coudert spent 3 months there in 2011, joint participation in many european projects.

Salerno, Italy: Visits of L. Gargano and U. Vaccaro (University of Salerno) and joint publications.

8.3.3. Visits of International Scientists

Jørgen Bang-Jensen: University of Southern Denmark, Odensee, Denmark, October 10-October 30, 2011 (3 weeks).
Victor Campos: Universidade Federal do Ceará, Fortaleza, Brazil, November 28 - December 4 (1 week).
Grit Classen: Lehrstuhl II fur Mathematik, RWTH Aachen - Aachen, Germany, September 11-16, 2011 (1 week) and December 12-16 (1 week).
Li Da Tong: National Sun Yat-Sen University, Kaohsiung, Taiwan, November 25 - December 2 (1 week).
Michele Flammini: University of l’Aquila, Italy, June 18 - July 9 (3 weeks).
Fedor V. Fomin: University of Bergen, Bergen, Norway, April 4 - April 30, 2011 (1 month) and November 16-18 (Colloquium Morgenstern).
Luisa Gargano: Dipartimento di Informatica ed Applicazioni “Renato M. Capocelli” of the Università di Salerno, Salerno, Italy, July 15 - August 31 (1 month 1/2).
Tomas Kaiser: University of West Bohemia, Pilsen, Czech Republic, November 28 - December, 4 (1 week).
Arie Koster: Lehrstuhl II fur Mathematik, RWTH Aachen - Aachen, Germany, September 11-16, 2011 (1 week).
Daniel Král’: Charles University, Prague, Czech Republic, October 17-21, 2011 (1 week);
Manuel Kutschka: Lehrstuhl II fur Mathematik, RWTH Aachen - Aachen, Germany, September 11-16, 2011 (1 week) and December 12-16 (1 week).
Joseph Peters: SFU Vancouver, Canada, May 14 - June, 4 (3 weeks).
Ivan Rapaport: Universidad de Chile, Santiago, Chile, May, 2011 (2 weeks).
András Sebő: G-SCOP, Grenoble, October 19-21, 2011 (3 days).
Karol Suchan: Universidad Adolfo Ibáñez, Santiago, Chile, September 21 - December 28, 2011 (3 months).
Amel Tandjaoui: University of Oran, Algeria, November 7-25, 2011 (3 weeks).
Ugo Vaccaro: Dipartimento di Informatica ed Applicazioni “Renato M. Capocelli” of the Università di Salerno, Salerno, Italy, July 15- August 31 (1 month 1/2).
Gabriel Wainer: Carleton University, Ottawa, Canada, January 19-24 (1 week) and June 13 - July 8 (3 weeks).
Joseph Yu: Abbotsford and SFU, Vancouver, Canada, March 1st - April 15, 2011 (1 month 1/2).

8.3.4. Visits of Mascotte Members to Other Research Institutions

J. Araújo: Visit to Federal University of Ceará, Fortaleza, Brazil (December 22th, 2010 - January 15th, 2011).
J. Burman: Visit to LRI, University Paris-Sud 11, Orsay, France, (January 31-February 3, 2011).
N. Cohen: Visit to University of Bergen, Norway (February 12-27, 2011); Visit the National Taiwan University, Taipei, Taiwan (March 9–16, 2011).
D. Coudert: Visit the Research Unit 1 (RU1) of the Research Academic Computer Technology Institute (RACTI), Patras, Greece (January 8 till March 31, 2011); Visit the mathematics department of the National and Kapodistrian University of Athens, Greece (February 23-25, 2011); Visit the mathematics department of RWTH Aachen, Germany (October 30 till November 4, 2011).
O. Dalle: Visit to Carleton University, Ottawa, Canada (July 5 - August 3 2011).
G. D’Angelo: Visit University of L’Aquila, L’Aquila, Italy (November 5-14 and December 12-15); Visit “Sapienza” University of Rome, Rome, Italy (November 8).
F. Havet: National Taiwan University, Taipei, Taiwan (March 9-12 and 17-18, 2011); National Sun Yat Sen University, Kioashung, Taiwan (March 13-16); Federal University of Ceara, Fortaleza, Brasil (April 4-8, 2011 and September 27-October 4, 2011); LIRMM, University Montpellier 2, (February 7-11, 2011 and October 14-15, 2011); LIFO, University of Orléans, (May 18-22, 2011); Lebanese University, Beyruth, Lebanon (May 16-20, 2011).
A. Kodjo: Visit RWTH Aachen University, Germany (December 5-9, 2011).
A. Lancin: Visit to Louvain-la-Neuve University, Belgium, (July 8, 2011).
E. Mancini: Visit to Carleton University, Ottawa, Canada (September 5-October 4-2011).
V. D. Nguyen: Visit to Carleton University, Ottawa, Canada (August 7-September 4 2011).
N. Nisse: Visit to Universidad de Chile, Santiago, Chile, (2 weeks, January 13-31, 2011); Visit to CITI, Lyon, France, (1 week, July 25-29, 2011).
I. Tahiri: Visit RWTH Aachen University, Germany (July 4-15, 2011 and December 5-9, 2011);

8.3.5. Internships

D. Coudert: supervised the internship of Felipe Menezes Machado (Universidade Federal de Minas Gerais, Belo Horizonte, Brasil) on studying community structures in dynamic graphs, April-June 2011 (3 months 1/2).
J. Moulierac: supervised the internship of Truong Khoa Phan (parcours UBINET master IFI, UNS, France) on Minimization of network power consumption with WAN Optimization, March-August 2011 (6 months).
N. Nisse: supervised the internship of Dang Dinh Khanh (parcours UBINET master IFI, UNS, France) on the study of variants of Cops and Robber Games, March-August 2011 (5 months 1/2).

8.3.6. Participation In International Programs

INRIA FUNCAP (Inria-FAP): ALERTE (ALgoritmes Efficaces pour les Réseaux de Téléccommunications), with Pargo Team, Universidade Federal do Ceará, Brazil, accepted in June 2011.
INRIA Conicyt: PhD Grant of J.-C. Maureira supervised by J.-C. Bermond and O. Dalle.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. CIMENT

The CIMENT project (Intensive Computing, Numerical Modeling and Technical Experiments, \url{https://ciment.ujf-grenoble.fr/}) gathers a wide scientific community involved in numerical modeling and computing (from numerical physics and chemistry to astrophysics, mechanics, bio-modeling and imaging) and the distributed computer science teams from Grenoble. Several heterogeneous distributed computing platforms were set up (from PC clusters to IBM SP or alpha workstations) each being originally dedicated to a scientific domain. More than 600 processors are available for scientific computation. The MESCAL project-team provides expert skills in high performance computing infrastructures.

8.1.2. High Performance Computing Center

- The ICluster2, the IDPot and the new Digitalis Platforms

The MESCAL project-team manages a cluster computing center on the Grenoble campus. The center manages different architectures: a 48 bi-processors PC (ID-POT), and the center is involved with a cluster based on 110 bi-processors Itanium2 (ICluster-2) and another based on 34 bi-processor quad-core XEON (Digitalis) located at Inria. The three of them are integrated in the Grid’5000 grid platform.

More than 60 research projects in France have used the architectures, especially the 204 processors Icluster-2. Half of them have run typical numerical applications on this machine, the remainder has worked on middleware and new technology for cluster and grid computing. The Digitalis cluster is also meant to replace the Grimage platform in which the MOAIS project-team is very involved.

- The Bull Machine

In the context of our collaboration with Bull the MESCAL project-team exploits a Novascale NUMA machine. The configuration is based on 8 Itanium II processors at 1.5 Ghz and 16 GB of RAM. This platform is mainly used by the Bull PhD students. This machine is also connected to the CIMENT Grid.

- GRID 5000 and CIMENT

The MESCAL project-team is involved in development and management of Grid’5000 platform. The Digitalis and IDPot clusters are integrated in Grid’5000. Moreover, these two clusters take part in CIMENT Grid. More precisely, their unused resources may be exploited to execute jobs from partners of CIMENT project.

8.2. National Initiatives

8.2.1. "Action d’envergure"

- HEMERA, 2010-2012

Leading action "Completing challenging experiments on Grid’5000 (Methodology)"

Experimental platforms like Grid’5000 or PlanetLab provide an invaluable help to the scientific community, by making it possible to run very large-scale experiments in con- trolled environment. However, while performing relatively simple experiments is generally easy, it has been shown that the complexity of completing more challenging experiments (involving a large number of nodes, changes to the environment to introduce heterogeneity or faults, or instrumentation of the platform to extract data during the experiment) is often underestimated.
This working group explores different complementary approaches, that are the basic building blocks for building the next level of experimentation on large scale experimental platforms. This encompasses several aspects.

8.2.2. ARC Inria

- **Meneur 2011-2013**

  Partners: EPI Dionysos, EPI Maestro, EPI MESCAL, EPI Comore, GET/Telecom Bretagne, FTW, Vienna (Forschungszentrum Telekommunikation Wien), Columbia University, USA, Pennsylvania State University, USA, Alcatel-Lucent Bell Labs France, Orange Labs.

  The goal of this project is to study the interest of network neutrality, a topic that has recently gained a lot of attention. The project aims at elaborating mathematical models that will be analyzed to investigate its impact on users, on social welfare and on providers’ investment incentives, among others, and eventually propose how (and if) network neutrality should be implemented. It brings together experts from different scientific fields, telecommunications, applied mathematics, economics, mixing academy and industry, to discuss those issues. It is a first step towards the elaboration of a European project.

8.2.3. ADT Inria (2)

- **SimGrid for Human Beings, 2009-2011**

  Partners: Inria Grand Est. Two young engineers have been allotted by the Inria to the SimGrid project to help with the software maintenance and with the transfer of research ideas and prototypes from the ANR USS SimGrid to public stable versions.

- **Aladdin-G5K, 2008-2011**

  Partners: Inria FUTURS, Inria Sophia, IRISA, LORIA, IRIT, LABRI, LIP, LIFL.

  After the success of the Grid’5000 project of the ACI Grid initiative led by the French ministry of research, Inria is launching the ALADDIN project to further develop the Grid’5000 infrastructure and foster scientific research using the infrastructure.

  ALADDIN built on Grid’5000’s experience to provide an infrastructure enabling computer scientists to conduct experiments on large scale computing and produced scientific results that can be reproduced by others. MESCAL members are particularly involved in efficient large scale system utilization, providing confidence to the user about the infrastructure and modeling of large scale systems and validation of their simulators.

8.2.4. NANO 2012

Rapid advances in multi-core technologies have been incorporated in general-purpose processors from Intel, IBM, Sun, and AMD, and special-purpose graphics processors from NVIDIA and ATI. This technology will soon be introduced to the next generation of processors in embedded systems. The increase in the number of cores per processor will introduce critical challenges for the access of data stored in memory. The synchronization of memory accesses is often done using the use of locks for shared variables. As the number of threads increases, the cost of synchronization also increases due to increased access to these shared variables. Transactional memory is currently an approach being actively investigated. The goal of this project is to improve the programability and performance of parallel systems using the approach of transactional memory in the context of embedded systems.

8.2.5. ANR Jeunes Chercheurs et Jeunes Chercheuses (2)

- **DOCCA, 2007-2011**

  The race towards the design and development of scalable distributed systems offers new opportunities to applications, in particular as far as scientific computing, databases, and file sharing are concerned. Recently many advances have been done in the area of large-scale file-sharing systems, building upon the peer-to-peer
paradigm that somehow seamlessly responds to the dynamicity and resilience issues. However, achieving a fair resource sharing amongst a large number of users in a distributed way is clearly still an open and active research field. For all previous issues there is a clear gap between:

1. widely deployed systems as peer-to-peer file-sharing systems (KaZaA, Gnutella, EDonkey) that are generally not very efficient and do not propose generic solutions that can be extended to other kind of usage;
2. academic work with generally smart solutions (probabilistic routing in random graphs, set of node-disjoint trees, Lagrangian optimization) that sometimes lack a real application.

Up to now, the main achievements based on the peer-to-peer paradigm mainly concern file-sharing issues. We believe that a large class of scientific computations could also take advantage of this kind of organization. Thus our goal is to design a peer-to-peer computing infrastructure with a particular emphasis on the fairness issues. In particular, the objectives of the ANR DOCCA (Design and Optimization of Collaborative Computing Architectures) project are the following:

First, we want to combine theoretical tools and metrics from the parallel computing community and from the network community, and to explore algorithmic and analytical solutions to the specific resource management problems of such systems.

We also want to design a P2P architecture based on the algorithms designed in the second step, and to create a novel P2P collaborative computing system.

- Clouds@home, 2009-2013

The overall objective of this project is to design and develop a cloud computing platform that enables the execution of complex services and applications over unreliable volunteered resources over the Internet. In terms of reliability, these resources are often unavailable 40% of the time, and exhibit frequent churn (several times a day). In terms of “real, complex services and applications”, we refer to large-scale service deployments, such as Amazon’s EC2, the TeraGrid, and the EGEE, and also applications with complex dependencies among tasks. These commercial and scientific services and applications need guaranteed availability levels of 99.999% for computational, network, and storage resources in order to have efficient and timely execution.

8.2.6. ANR COSI

- PROHMPT, 2009-2011

Partners: Bull SAS, CAPS entreprise, CEA CESTA, CEA INAC, Inria RUNTIME, UVSQ PriSM

Processor architectures with many-core processors and special-purpose processors such as GPUs and the CELL processor have recently emerged. These new and heterogeneous architectures require new application programming methods and new programming models. The goal of the ProHMPT project is to address this challenge by focusing on the immense computing needs and requirements of real simulations for nanotechnologies. In order for nanosimulations to fully leverage heterogeneous computing architectures, project members will novel technologies at the compiler, runtime, and scientific kernel levels with proper abstractions and wide portability. This project brings experts from industry, in particular HPC hardware expertise from Bull and nanosimulation expertise from CEA.

8.2.7. ANR ARPEGE

- PEGASE, 2009-2011

Partners: RealTimeAtWork, Thales, ONERA, ENS Cachan

The goal of this project to achieve performance guarantees for communicating embedded systems. Members will develop mathematical methods that give accurate bounds on maximum network delays in both space and aviation systems. The mathematical methods will be based on Network Calculus theory, which is type of queuing theory that deals with worst-case performance evaluation. The expected results will be novel models and software tools validated in mission-critical real-time embedded networks of the aerospace industry.
8.2.8. ANR SEGI (2)

- **USS Simgrid, 2009-2011**

  Partners: Inria Nancy, Inria Sophia, Inria Bordeaux, University of Reims, IN2P3, University of Hawaii at Manoa

  The goal of the USS-SimGrid project is to enable scalable and accurate simulations by means of the SimGrid simulation toolkit. This toolkit is widely used for simulation of Grid systems. We aim to extend the functionality of the toolkit to enable the simulation of heterogeneous systems with more than tens of thousands of nodes.

  There are three main thrusts in this project. First, we improve the models used in SimGrid, increasing their scalability and easing their instantiation. Second, we develop tools that ease the analysis of detailed and large simulation results, and aid the management of simulation deployments. Third, we improve the scalability of simulations using parallelization and optimization methods. A mid-term report summarizing our findings has been published in [59].

- **SPADES, 2009-2012**

  Partners: Inria GRAAL, Inria GRAND-LARGE, CERFACS, CNRS, Inria PARIS, LORIA

  Petascale systems consisting of thousands to millions of resources have emerged. At the same, existing infrastructure are not capable of fully harnessing the computational power of such systems. The SPADES project will address several challenges in such large systems. First, the members are investigating methods for service discovery in volatile and dynamic platforms. Second, the members creating novel models of reliability in PetaScale systems. Third, the members will develop stochastic scheduling methods that leverage these models. This will be done with emphasis on applications with task dependencies structured as graph.

8.3. European Initiatives

8.3.1. **FP7 EDGI (European Desktop Grid Initiative)**

  Partners: SZTAKI institute (Hungary), CIEMAT (Spain), Univ. Coimbra (Portugal), Univ Cardi (UK), Univ Westminster (UK), AlmereGrid (NL), IN2P3 (FR), Inria (GRAAL, MESCAL)

  Years: 2010-2012

  EDGI is an FP7 European project whose goal is to build a Grid infrastructure composed of "Desktop Grids", such as BOINC or XtremWeb, where computing resources are provided by Internet volunteers, and "Service Grids", where computing resources are provided by institutional Grid such as EGEE, gLite, Unicore and "Clouds systems" such asOpenNebula and Eucalyptus, where resources are provided on-demand. The EDGI infrastructure will consist of Service Grids that are extended with public and institutional Desktop Grids and Clouds.

8.3.2. **FP7 Mont-Blanc project: European scalable and power efficient HPC platform based on low-power embedded technology**

  FP7 Programme: ICT-2011.9.13 Exa-scale computing, software and simulation

  Mont-Blanc Partners: BSC (Barcelone), Bull, ARM (UK), Julich (Germany), Genci, CINECA (Italy), CNRS (LIRMM, LIG)

  Duration: 3 Years from 1/10/2011

  There is a continued need for higher compute performance: scientific grand challenges, engineering, geophysics, bioinformatics, etc. However, energy is increasingly becoming one of the most expensive resources and the dominant cost item for running a large supercomputing facility. In fact, the total energy cost of a few years of operation can almost equal the cost of the hardware infrastructure. Energy efficiency is already a primary concern for the design of any computer system and it is unanimously recognized that Exascale systems will be strongly constrained by power.
The analysis of the performance of HPC systems since 1993 shows exponential improvements at the rate of one order of magnitude every 3 years: One petaflops was achieved in 2008, one exaflops is expected in 2020. Based on a 20 MW power budget, this requires an efficiency of 50 GFLOPS/Watt. However, the current leader in energy efficiency achieves only 1.7n GFLOPS/Watt. Thus, a 30x improvement is required.

In this project, the partners believe that HPC systems developed from today’s energy-efficient solutions used in embedded and mobile devices are the most likely to succeed. As of today, the CPUs of these devices are mostly designed by ARM. However, ARM processors have not been designed for HPC, and ARM chips have never used in HPC systems before, leading to a number of significant challenges.

8.3.3. HPC-GA project: High Performance Computing for Geophysics Applications

FP7 programme: Marie Curie Actions, International Research Staff Exchange Scheme (IRSES)
Partners: Inria (Grenoble, Bordeaux, Pau), BCAM (Bilbao), UFRGS (Brazil), UNAM (Mexico), BRGM (France), UJF (France)
Duration: 3 years from 1/1/2012
PI: Inria (Grenoble and Bordeaux)

Simulating large-scale geophysics phenomenon represents, more than ever, a major concern for our society. Recent seismic activity worldwide has shown how crucial it is to enhance our understanding of the impact of earthquakes. Numerical modeling of seismic 3D waves obviously requires highly specific research efforts in geophysics and applied mathematics, leveraging a mix of various schemes such as spectral elements, high-order finite differences or finite elements. But designing and porting geophysics applications on top of nowadays supercomputers also requires a strong expertise in parallel programming and the use of appropriate runtime systems able to efficiently deal with heterogeneous architectures featuring many-core nodes typically equipped with GPU accelerators. The HPC-GA project aims at evaluating the functionalities provided by current runtime systems in order to point out their limitations. It also aims at designing new methods and mechanisms for an efficient scheduling of processes/threads and a clever data distribution on such platforms.

8.3.4. Collaborations in European Programs, except FP7

- ESPON:
  The MESCAL project-team participates to the ESPON (European Spatial Planning Observation Network) http://www.espon.lu/ It is involved in the action 3.1 on tools for analysis of socio-economical data. This work is done in the consortium hypercarte including the laboratories LIG, Géographie-cité (UMR 8504) and RIATE (UMS 2414). The Hyperatlas tools have been applied to the European context in order to study spatial deviation indexes on demographic and sociological data at nuts 3 level.

- European Exascale Software Initiative (EESI)
  The objective of this Support Action, co-funded by the European Commission is to build a European vision and road-map to address the challenges of the new generation of massively parallel systems composed of millions of heterogeneous cores which will provide Petaflop performances in 2010 and Exaflop performances in 2020 (the speed of a supercomputer is measured in "FLOPS" (FLoating Point Operations Per Second)), "Petascale" supercomputers can process one quadrillion (1015) (1000 trillion) FLOPS, Exascale is computing performance is one quintillion (1018) FLOPS (one million teraflops) http://www.eesi-project.eu/pages/menu/homepage.php.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. Cloud Computing at Home

Title: Cloud Computing over Internet Volunteer Resources
Inria principal investigator: Derrick Kondo

International Partner:
   Institution: University of California Berkeley (United States)
   Laboratory: Space Sciences Laboratory
   Researcher: David P.

Duration: 2009 - 2011
See also: http://abenaki.imag.fr/cloudcomputing/pmwiki.php

Recently, a new vision of cloud computing has emerged where the complexity of an IT infrastructure is completely hidden from its users. At the same time, cloud computing platforms provide massive scalability, 99.999% reliability, and speedy performance at relatively low costs for complex applications and services. In this proposed collaboration, we investigate the use of cloud computing for large-scale and demanding applications and services over the most unreliable but also most powerful resources in the world, namely volunteered resources over the Internet. The motivation is the immense collective power of volunteer resources (evident by FOLDING@home’s 3.9 PetaFLOPS system), and the relatively low cost of using such resources. We will address these challenges drawing on the experience of the BOINC team which designed and implemented BOINC (a middleware for volunteer computing that is the underlying infrastructure for SETI@home), and the MESCAL team which designed and implemented OAR (an industrial-strength resource management system that runs across France’s main 5000-node Grid called Grid’5000).

8.4.1.2. DIODEA

Title: France/Brazil Associated research team on Parallel Computing
Inria principal investigator: Bruno Raffin

International Partner:
   Institution: Universidade Federal do Rio Grande do Sul (Brazil)
   Laboratory: UFRGS
   Researcher: Philippe Olivier Alexandre Navaux

Duration: 2009 - 2011
See also: http://diodea.imag.fr/

Associate Team funded by Inria with the MOAIS project-team of Inria, and the Brazilian University UFRGS. The goal of this project is to design and develop programming tools for grid and clusters for virtual reality. This collaboration was initiated 10 years ago, and has greatly affected the activities (doctoral, publications and joint production software) of the Apache project-team, from which MOAIS and MESCAL were formed. In particular, four PhD Brazilian students have joined the MESCAL project-team as a result of this long-standing collaboration. This year, 3 members of the MESCAL project-team visited Brazil (Jean-François Méhaut, Arnaud Legrand, Jean-Marc Vincent) to enhance the existing collaborations and to form new ones.

8.4.2. Inria International Partners

- MESCAL has strong connections with both UFRGS (Porto Alegre, Brazil) and USP (Sao Paulo, Brazil). This year, Jean-François Méhaut visited both laboratories in July. The creation of the LICIA common laboratory (see next section) will make this collaboration even tighter.
- MESCAL has strong bounds with the University of Illinois Urbana Champaign, within the (Joint Laboratory on Petascale Computing (see next section).
- MESCAL also has long lasting collaborations with University of California in Berkeley and a new one with Google. Derrick Kondo is being visiting them in October and November.
- Vania Martin has been visiting the Pontifícia Universidade Catolica de Minas Gerais (Belo Horizonte, Brazil).

8.4.3. Participation In International Programs

8.4.3.1. Africa

- SARIMA and IDASCO / LIRIMA (Cameroon)

MESCAL takes part in the SARIMA (Soutien aux Activités de Recherche Informatique et Mathématiques en Afrique http://www-direction.inria.fr/international/AFRIQUE/sarima.html ) project and more precisely with the University of Yaoundé 1. Cameroon student Blaise Yenké completed his PhD under the joint supervision of Professor Maurice Tchuenté. SARIMA also funded Adamou Hamza to prepare his Master Thesis during three months in the MESCAL project-team. SARIMA proposed J-F Méhaut to give a course on Operating System and Networks at Master Research Students. In addition, MESCAL participates in the IDASCO joint project with the University of Yaoundé 1. This is part of the international LIRIMA laboratory, whose goal to develop novel methods and tools for collecting and analyzing massive data sets from biological or environmental domains.

8.4.3.2. North America

- Google Derick Kondo has received a Google Research Award in 2011 for his proposal on predicting idleness in data centers. The technical goal of the proposed work is to give probabilistic guarantees on when data centers are idle. The implication of such predictions is improved data center utilization, while reducing and amortizing monetary costs. The general goal of this award is to facilitate collaboration between Google Inc. and academic researchers. Google Inc. provides the award as an unrestricted gift without constraints on intellectual property.
- Amazon (2010-2011) The overall goal is to integrate G5K with Amazon Inc’s Elastic Compute Cloud (EC2) such that workload, especially during peak periods, can be rerouted to EC2. So we would like to adapt OAR for an on-demand cloud infrastructure. We envision an OAR server, running within G5K, that manages sites within G5K and remote instances in EC2.
- JLPC (Joint Laboratory on Petascale Computing) (with University of University of Illinois Urbana Champaign. Several members of MESCAL are partners of this laboratory, and have paid several visits to Urbana-Champaign. The latest workshop of the laboratory has been organized by Jean-François Méhaut in Grenoble.

8.4.3.3. South America

- LICIA. The CNRS, Inria, the Universities of Grenoble, Grenoble INP and Universidade Federal do Rio Grande do Sul have created the LICIA (laboratoire International de Calcul intensif et d’Informatique Ambiante). On the French side, the laboratory is co-directed by Yves Denneulin and Jean-Marc Vincent.

The grand opening workshop has taken place in Porto Alegre, Brazil from Oct. 31st to Nov. 1st.

The main themes are artificial intelligence, high performance computing, information representation, interfaces and visualization as well as distributed systems.

More information can be found on http://www.inf.ufrgs.br/licia/ .
8. Partnerships and Cooperations

8.1. Regional Initiatives

- CILOE, 2008-2011, Minalogic: This project is to develop tools and high level interfaces for compute-intensive applications for nano and micro-electronic design and optimizations. The partners are: two large companies CS-SI (leader), Bull; three small size companies EDXACT, INFINISCALE, PROBAYES; and four research units INRIA, CEA-LETI, GIPSA-LAB, TIMA. For Moais, the contract funds the PhD thesis of Jean-Noel Quintin.

- HiPeComp, NANO 2008-2012 contract. The project HiPeCoMP (High Performance Components for MPSoC) consists in the development an coupling of: on the one hand, wait-free scheduling techniques (pre-partitioning and mapping, on-line work stealing) of component based multimedia applications on MPSoC architectures; and on the other hand, monitoring, debug and performance software tools for the programming of MPSoC with provable performances. For Moais, the contract funds the PhD thesis of Christophe Laferrière who started on 1/9/2009.

- SHIVA, Minalogic 2009-2012 contract. This project aims at the development of a high throughput backbone ciphering that ensures a high level of security for intranet and extranet communications over internet. The partners are: CS-SI (leader); 1 small size companies: Easii-IC (support for Xilinx FPGA); IWall-Mataru (key management), Netheos (customizable FPGA for ciphering); INRIA; CEA-LETI (security certification); Grenoble-INP (TIMA lab, integration of cryptography on FPGA); UJF (LJK and Institut Fourier: open cryptographic protocols and handshake; VERIMAG: provable security). Within INRIA, the MOAIS and the PLANET teams provide the parallel implementation on a multicore ptaform of IP-Sec and coordination with hardware accelerators (Frog’s and GPUs). The contract funds the PhD thesis of Ludovic Jacquin, coadvised by PLANET and MOAIS and a 1 year engineer (Fabrice Schuler, from 11/2010).

- SOC-TRACE, Minalogic 2011-2014 contract. This project aims the development of tools for the monitoring and debug of multicomputer systems on chip. Leader: ST-Microelectronic. Partners: Inria (Mescal, Moais); UJF (TIMA, LIG/Hadas); Magilem, ProBayes. The contract funds 1 PhD thesis and 1 year engineer.

8.2. National Initiatives

- ANR EXAVIZ (2011-2015). Large-scale interactive visual analysis for life sciences and materials. Partners: project-team INRIA MOAIS, LIFO-lab Université d’Orléans, Laboratoire de Biochimie Théorique de l’IBPC, the LIMSI lab and the CEMHTI.


• New accepted ANR HPAC (2012-2015). High Performance Algebraic Computing. Coordinator: Jean-Guillaume Dumas (CASY team, LJK, Grenoble). Partners: project-team MOAIS (Grenoble), team CASYS (LJK, Grenoble), project-team ARENAIRE (LIP, Lyon), project-team SALSA (LIP6, Paris), the ARITH group (LIRMM lab, Montpellier).

8.3. European Initiatives

8.3.1. FP7 Projet

8.3.1.1. VISIONAIR

Title: VISIONAIR
Type: CAPACITIES (Infrastructures)
Instrument: Combination of COLLABORATIVE PROJECTS and COORDINATION and SUP-PORT ACTIONS (CPCSA)
Duration: February 2011 - January 2015
Coordinator: Grenoble-INP (France)
VISIONAIR European platform. With the Grimage platform, we participate to the European project Visionair which objective is to provide an infrastructure that gathers advanced visualization and interaction infrastructures. Visionair is leaded by Grenoble-INP (Frédéric Noel, G-Scop lab) and gathers 25 international partners from 12 countries; it has been funded in 2010 and start in Q1 2011.

8.4. International Initiatives

8.4.1. INRIA Associate Teams

8.4.1.1. DIODEA

Title: Parallel and distributed computing, scalability and visualization
INRIA principal investigator: Bruno Raffin
International Partner:
  Institution: Federal University of Rio Grande del Sul (Brazil)
  Laboratory: Instituto de Informática
  Researcher: Philippe Navaux
Duration: 2006 - 2011
See also: http://diodea.imag.fr/
The French research teams MOAIS and MESCAL, Grenoble, INRIA, and the Brazilian University UFRGS, Porto Alegre closely collaborate since 1992. This collaboration is centered on: Grid computing tools related to system and application deployment, job scheduling, execution monitoring and visualisation ; Modeling, evaluating and experimenting on large scale computer systems (performance evaluation, experimentations, simulation, emulation) ; New parallel programming paradigms: work stealing, fault tolerance, processor and cache oblivious algorithms, multi-core and multi-GPU programming. Frequent visits between partners and numerous co-advised Master and Ph.D. students make it a really fruitful collaboration. It as a strong influence on the development of many of our software tools, including KAAPI, OAR, Kadeploy, Taktuk. We also share some of our computing resources. The cluster from UFRGS was integrated in 2009 as the first non european non of the Grid?5000 french experimental grid. The success of the associated team leads to the creation of the first Laboratoire International Associé (LIA) in computer science between the French CNRS and the Brazil.
8.4.2. Brazil

CAPES/COFECUB n° Ma660/10 (2010-2013) on the management of resources for parallel computing on a grid. Partners: University of Sao Paulo, project MOAIS.

8.5. Hardware Platforms

8.5.1. The GRIMAGE platform

The GrImage platform (http://grimage.inrialpes.fr) gathers a network of cameras and a PC cluster. It is dedicated to interactive applications. GrImage is co-led by the Moais and Perception projects. It is the milestone of a strong and fruitful collaboration between Moais and Perception (common publications, software and application development).

GrImage (Grid and Image) aggregates commodity components for high performance video acquisition, computation and graphics rendering. Computing power is provided by a PC cluster, with some PCs dedicated to video acquisition and others to graphics rendering. A set of digital cameras enables real time video acquisition. The main goal is to rebuild in real time a 3D model of a scene shot from different points of view. Visualization can be performed using a head mounted display for first-person interactions or on a multi-projector display-wall for high resolution rendering.

Since July 2009, the computing cluster was upgraded through grants from INRIA and CNRS-LIG. Grimage uses some specific nodes from the Digitalis machine capable of hosting several daughter boards (mainly video acquisition and graphics cards). It relies on Intel Nehalem processors and a high speed Infiniband network. This integrated approach will enable to test interactive applications using a very high number of processing resources as other nodes from the Digitalis machine can be reserved if needed.

8.5.2. The Digitalis machine

Digitalis is a 780 cores cluster based on Intel Nehalem processors and Infiniband network located at INRIA Rhône-Alpes. Digitalis has been designed to suit both the needs for batch computations and interactive applications. As mentioned before, one rack is dedicated to nodes hosting video acquisition boards and graphics cards. These nodes are mainly used for the Grimage platform, but can also be used for batch computing. Additional nodes with Nvidia Tesla GPUs have been installed.

By having a single unified machine for batch and interactive computing we expect to better use the available resources, favor the emergence of high performance applications integrating interactive steering and vice versa enable the development of a new generation of interactive 3D applications using a significantly larger number of CPUs and GPUs that what has been done so far on the Grimage platform.

8.5.3. Multicore Machines

MOAIS invested in 2006 on two multicore architectures

- A 8-way 16-cores machine equipped with Itanium processors.
- A 8-way 16-cores machine equipped with dual core processors (total of 8 sockets) and 2 GPUs.

These set of machines have been extended in 2010 with a new machines:

- A 8-way, 48-cores machine equipped with 12-core AMD processors (total of 4 sockets)
- A 6-cores machine equipped with 8 GPUs

These machines enables us to keep-up with the evolution of parallel architectures and in particular today’s availability of large multi-core machines. They are used to develop and test parallel adaptive algorithms taking advantage of the processing power provided by the multiple CPUs and GPUs available.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. ASYST (2010-2013)

Participants: Françoise André, Christine Morin, Nikos Parlavantzas.

The objective of the ASYST project (Adaptation dynamique des fonctionnalités d’un SYSTème d’exploitation large échelle) funded by the Brittany council is to provide the view of an Operating System as an ’Infrastructure as a Service’ (IaaS) and even more as a set of adaptable services. The main functionalities of an Operating System such as memory allocation or job scheduling have to be dynamically adapted to cope with the ever changing environment. This project funds 50% of a PhD grant (Djawida Dib).

8.1.2. HOCL4WS (2010-2012)

Participants: Thierry Priol, Cédric Tedeschi.

The objective of the HOCL project funded by the Brittany council is to develop a prototype of a middleware system for the distributed execution of chemical programs (targeted for large scale platforms). This project funds 50% of a PhD grant (Marko Obrovac).

8.2. National Initiatives

8.2.1. AUTOCHEM ANR White Project (2007-2011)

Participants: Thierry Priol, Cédric Tedeschi.

The goal of the AUTOCHEM project funded under the ANR white program is the programming of desktop Grids using the chemical programming model (http://www.irisa.fr/myriads/collaborate/national/anr/autochem/). This project funds a PhD grant (Héctor Fernandez).

8.2.2. ECO-GRAPPE ANR ARPEGE Project (2009-2012)

Participant: Christine Morin.

The goal of the ECO-GRAPPE project (http://www.irisa.fr/myriads/collaborate/national/anr/autochem/) funded under the ANR ARPEGE program is to design, implement and validate energy saving policies in clusters. This project funds a PhD grant (Eugen Feller). Partners involved in the ECO-GRAPPE project are EDF R&D and Kerlabs.

8.2.3. COOP ANR COSINUS Project (2009-2012)

Participants: Christine Morin, Yvon Jégou.

The COOP project (http://coop.gforge.inria.fr/) funded under the ANR COSINUS program relates to multi level cooperative resource management. The two main goals of this project are to set up a cooperation as general as possible with respect to programming models and resource management systems (RMS) and to develop algorithms for efficient resource selection. Experimentations will be conducted in particular with the SALOME platform and TLSE as examples of programming environments and Marcel, DIET and XtreemOS as examples of RMS. Partners involved in the COOP project are the GRAAL and RUNTIME INRIA EPI, IRIT and EDF R&D. This project funds a research engineer (Yann Radenac).

8.2.4. CLOUD ANR project (October 2011 - September 2012)

Participant: Christine Morin.
The CLOUD project aims at extending an XtreemOS Grid with resources dynamically provisioned from IaaS clouds. An algorithm to select resources in a multi-cloud environment will be defined. A prototype based on XtreemOS Grid and OpenNebula and Nimbus clouds will be built. This project is related to the EIT ICT labs activity 10239 on cloud computing described in Section 8.3.2. It funds a research engineer.

8.2.5. **HEMERA INRIA AEN (2010-2013)**

**Participants:** Christine Morin, Yvon Jégou.

The Myriads team is involved in the HEMERA large wingspan project funded by INRIA (http://www.grid5000.fr/mediawiki/index.php/Hemera). This project aims at demonstrating ambitious up-scaling techniques for large scale distributed computing by carrying out several dimensioning experiments on the Grid’5000 infrastructure, at animating the scientific community around Grid’5000 and at enlarging the Grid’5000 community by helping newcomers to make use of Grid’5000. Yvon Jégou is co-chair of the "Bring Grids Power to Internet-Users thanks to Virtualization Technologies” working group.

8.2.6. **INRIA ADT Aladdin (2008-2012)**

**Participant:** Yvon Jégou.

The Aladdin technological development action funded by INRIA aims at the construction of a scientific instrument for experiments on large-scale parallel and distributed systems, building on the Grid’5000 platform (http://www.grid5000.fr). It structures INRIA’s leadership role as the institute is present in 8 of the 9 Grid’5000 sites distributed across France.

An executive committee, where each of the 10 project-teams supporting Grid’5000 in the 8 research centers is represented, meets every month. It gives recommendations to the directors on scientific animation, access policy to the instrument as well as for the hardware and software development according to the resources devoted to this ADT. Yvon Jégou represents INRIA Rennes in this executive committee.

The technical team is now composed of 12 engineers, of which 3 are hosted in the Myriads team (David Margery, technical director, (SED ² member), Pascal Morillon (SED member), Ghislain Charrier). This technical team is structured in a sysadmin team, managing the instrument, and a development team building the tools to build, execute and analyze experiments.

8.2.7. **INRIA ADT XtreemOS Easy (2010-2012)**

**Participants:** Christine Morin, Yvon Jégou.

The XtreemOS EASY technological development action funded by INRIA aims at developing a set of tools and environments to ease the installation, configuration, deployment, experimentation and use of the XtreemOS Grid operating system and at providing support to the XtreemOS open source community. Two associate engineers are involved in this project: Amine Belhaj and Rémy Garrigue. David Margery (SED) is tutoring them in software development.

8.2.8. **INRIA ADT DAUM (2011-2012)**

**Participants:** Erwan Daubert, Jean-Louis Pazat.

We participate to the ADT DAUM which is coordinated by the Triskell Team. DAUM is a a Technology Development Action (ADT) by INRIA aiming at providing an integrated platform for distributed dynamically adaptable component based applications. DAUM unites and integrates results and software from the Triskell EPI and the Myriads team. More precisely, DAUM extends the Kevoree component framework designed by Triskell with adaptation mechanisms from the SAFDIS framework designed by Myriads.

²The SED is the INRIA Experimentation and Development Service.
DAUM will evaluate this integration by designing a full scale system for a tactical assistant for firefighter officers, in collaboration with the firefighters organization of Ille et Vilaine department (2800 firefighters).

- Project duration: October 2011 - September 2012
- Triskell budget share: One associated engineer shared with the Triskell EPI
- Project Coordinator: Noël Plouzeau, Triskell INRIA Project.
- Participants: Myriads, Triskell.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. S-CUBE (2008-2012)

Françoise André, Jean-Louis Pazat

- Title: S-Cube: Software Services and Systems Network
- Type: COOPERATION (ICT)
- Defi: Service & software architectures, infrastructures and engineering
- Instrument: Network of Excellence (NoE)
- Duration: March 2008 - February 2012
- Coordinator: Universität Duisburg-Essen (Germany)

- Others partners: University of Duisburg-Essen, Paluno - Ruhr Institute for Software Technology (Germany); Tilburg University (Netherlands); City University London (U.K.); Consiglio Nazionale delle Ricerche (Italy); Center for Scientific and Technological Research, FBK (Italy); Lero - The Irish Software Engineering Research Centre (Ireland); Politecnico di Milano (Italy); MTA SZTAKI – Computer and Automation Research Institute (Hungary); University of Technology (Austria); Université Claude Bernard Lyon (France); University of Crete (Greece); Universidad Politécnica de Madrid (Spain); University of Stuttgart (Germany); University of Hamburg (Germany); Vrije University Amsterdam (Netherlands)

- See also: http://www.s-cube-network.eu/

Abstract: S-Cube is the European network of excellence in software services and systems federating the software engineering and distributed system research communities to shape the Internet of Services (http://www.s-cube-network.eu/). The MYRIADS team is involved in service discovery, coordination and adaptation. Three PhD thesis grants are funded by the S-Cube project.

8.3.1.2. CONTRAIL (2010-2013)

Yvon Jégou, Christine Morin

- Title: Contrail, Open Computing Infrastructures for Elastic Services
- Type: COOPERATION (ICT)
- Defi: Internet of Services, Software & Virtualisation
- Instrument: Integrated Project (IP)
- Duration: October 2010 - September 2013
- Coordinator: INRIA (France)

- Others partners: XLAB Razvoj Programske Opreme In Svetovanje d.o.o., Slovenia; Italian National Research Council, ISTI-CNR & IIT-CNR, Italy; Vrije Universiteit Amsterdam, The Netherlands; Science and Technology Facilities Council, STFC, UK; Genias Benelux bv, The Netherlands; Tiscali Italia SpA, Italy; Konrad-Zuse-Zentrum für Informationstechnik Berlin, ZIB, Germany; Hewlett Packard Italiana S.r.l - Italy Innovation Center, Italy; Country Constellation Technologies Ltd, UK; EBM WebSourcing, France;
See also: http://www.contrail-project.eu

Abstract: The goal of the Contrail project is to design, implement, evaluate and promote an open source system for Cloud Federations. To allow open access to shared computing resources, the vision of the Contrail project is that any organization should be able to be both a Cloud provider when its IT infrastructure is not used at its maximal capacity, and a Cloud customer in periods of peak activity. Resources that belong to different operators will be integrated into a single homogeneous Federated Cloud that users can access seamlessly.

Contrail will vertically integrate an open-source distributed operating system for autonomous resource management in Infrastructure-as-a-Service environments, and high level services and runtime environments as foundations for Platform-as-a-Service. Contrail will address key technological challenges in existing commercial and academic Clouds: the lack of standardized rich and stable interfaces; limited trust from customers; and relatively poor Quality of Service (QoS) guarantees regarding the performance and availability of Cloud resources.

8.3.1.3. SCALUS Marie Curie Initial Training Networks (MCITN) (2009-2013)

Christine Morin

Title: SCALUS - SCALing by means of Ubiquitous Storage
Type: PEOPLE (ICT)
Defi: elevating education, research, and development inside the area of storage architectures with a focus on cluster, grid, and cloud storage
Instrument: Marie Curie Initial Training Networks (MCITN)
Duration: 4 years
Coordinator: Padeborn University, Germany

Others partners: Paderborn Center for Parallel Computing (PC2), Germany ; BSC, Spain ; Durham University, UK ; Goethe Universität Frankfurt, Germany ; FORTH-ICS, Greece ; Universidad Politecnica De Madrid, Spain ; Ecole des Mines de Nantes, France ; XLAB, Slovenia ; Universität Hamburg, Germany ; Xyratex, UK ; Fujitsu Technology Solutions GmbH, Germany (associated partner) ; CERN, Switzerland (associated partner) ; Microsoft Research, UK (associated partner) ; NEC, Germany (associated partner) ; ORACLE, Germany (associated partner).

See also: http://www.scalus.eu/

Abstract: The consortium of this Marie Curie Initial Training Network (MCITN) SCALing by means of Ubiquitous Storage (SCALUS) aims at elevating education, research, and development inside the area of storage architectures with a focus on cluster, grid, and cloud storage. The vision of the SCALUS MCITN is to deliver the foundation for ubiquitous storage systems, which can be scaled in arbitrary directions (capacity, performance, distance, security, . . .). The consortium involves 8 full academic partners, 2 full industrial partners and 5 additional associated industrial partners. Christine Morin participates in this project by co-advising with Professor Ludwig from the University of Hamburg a PhD student (Amandine Pignier) working on Load Balancing and Scheduling in Parallel and Cluster File Systems.

8.3.1.4. BonFire IP Project (2010-2013)

David Margery

Title: BonFIRE, Building service testbeds on FIRE
Type: COOPERATION (ICT)
Defi: Future Internet experimental facility and experimentally-driven research
Instrument: Integrated Project (IP)
Duration: June 2010 - November 2013
Coordinator: ATOS SPAIN SA (Spain)

Others partners: The university of Edinburgh (U.K.); SAP AG (Germany); Universitaet Stuttgart (Germany); Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forshung E.V (Germany); Interdisciplinary Institute for Broadband Technology (Belgium); Universidad Complutense De Madrid (Spain); Fundacio Privada I2CAT, Internet I Innovacio Digital A Catalunya (Spain); Hewlett-Packard Limited (U.K.); The 451 Group Limited (U.K.); Technische Universitat Berlin (Germany); Inria (France); Instytut Chemii Bioorganicznej Pan (Poland); Nextworks (Italy); Redzinc Services Limited (Ireland); Cloudium systems Limited (Ireland); Fundacio Centro Tecnologico De Supercomputacion De Galicia (Spain); Centre d’Excellence en technologies de l’Information et de la communication (Belgium); University of Manchester (U.K.);

See also: http://www.bonfire-project.eu/

Abstract: the BonFIRE (Building service testbeds for Future Internet Research and Experimentation) project will design, build and operate a multi-site cloud facility to support applications, services and systems research targeting the Internet of Services community within the Future Internet (http://www.bonfire-project.eu/). The MYRIADS team is involved in this project as it hosts the Aladdin ADT.

In the context of BonFIRE, we operate one of the five cloud sites integrated into the BonFIRE cloud federation. This cloud site is based on OpenNebula and can be extended on-request to all the machines of the local Grid’5000 site. We have also contributed to the cloud federation layer and host the integration infrastructure for the project, generated from configuration management tools using puppet.

8.3.1.5. IC0804 - Energy Efficiency in Large Scale Distributed Systems
Françoise André, Jean-Louis Pazat

This COST Action will propose realistic energy-efficient alternate solutions to share IT distributed resources (http://www.irit.fr/cost804/). As large scale distributed systems gather and share more and more computing nodes and storage resources, their energy consumption is exponentially increasing. While much effort is nowadays put into hardware specific solutions to lower energy consumptions, the need for a complementary approach is necessary at the distributed system level, i.e. middleware, network and applications. The Action will characterize the energy consumption and energy efficiencies of distributed applications. In his PhD thesis work, Eugen Feller is contributing to this COST action. He is one of the two co-proposers of a working group on energy and QoS-aware workload management in clouds.

8.3.2. Collaborations in European Programs, except FP7

Program: EIT ICT Labs
Project acronym: Activity 10239
Project title: Boosting Innovative Software in Cloud and Service Computing
Duration: January - December 2011
Coordinator: Christine Morin
Other partners: Institut Telecom Sud Paris (France), VTT (Sweden), SAP (Germany)

Abstract: This activity aims at building testbeds integrating XtreemOS and Contrail open source software and at experimenting these testbeds on large scale experimentation platforms such as Grid’5000 and BonFire. We organized an EIT ICT Labs summer school (jointly with Contrail European project) held June 27-July 1, 2011 in Presqu’île de Giens, France.

8.4. International Initiatives

8.4.1. INRIA Associate Teams

8.4.1.1. SEROS
Title: Scalable, Efficient, and Resilient Operating Systems
INRIA principal investigator: Christine Morin
International Partner: Stephen Scott

Institution: Oak Ridge National Laboratory (United States)
Laboratory: System Research Team

Duration: 2009 - 2011
See also: http://www.irisa.fr/myriads/ser-os/

The main objectives of the collaboration in the area of operating systems and system tools for HPC are: operating systems for HPC (focusing on system-level virtualization), system management tools for HPC platforms, and resilience for HPC systems.

8.4.1.2. DataCloud@Work

Title: DataCloud@Work
INRIA principal investigator: Gabriel Antoniu, Kerdata
International Partner: Valentin Cristea

Institution: University Polytechnical Bucharest (UPB)
Laboratory: Team of Prof. Valentin Cristea

Duration: 2010 - 2012
See also: http://www.irisa.fr/kerdata/doku.php?id=cloud_at_work:start

The goal of the Associated team is to study massive data management in cloud based service infrastructures. In this context, the Myriads team is involved in a study aiming at the integration of the BlogSeer large scale storage system in XtreemOS distributed system in a vision where XtreemOS is used for the management of IaaS clouds.

8.4.2. INRIA International Partners

Nikos Parlavantzas is collaborating with the team of Prof. Héctor Duran-Limon of the University of Guadalajara, Mexico on resource management in virtualised environments. We have produced a joint publication and are preparing an ANR project proposition[ 23 ].

Héctor Fernandez and Cédric Tedeschi collaborate with the team of Dr. Patricia Lago from Vrije University Amsterdam. Héctor spent 3 weeks there, working on the use of the Chemical Programming Model to implement a proof of concept of a method for Global Software Development developed in VUA’s team, financed by the S-Cube project.

Christine Morin has visited Professor Vladimir Getov, Westminster University, UK in February 2011. A PhD thesis topic in the area of cloud computing has been jointly proposed. Professor Vladimir Getov visited Myriads team in May 2011.

8.4.3. Visits of International Scientists

Chokchai Leangsuksun, Professor at Louisina Tech University (USA) spent one month and a half in the Myriads team in June and July 2011, as an invited professor, funded by the University of Rennes 1. We investigated potential joint research directions related to resilience in cloud computing [ 30 ].
8.4.3.1. Internships

Neha Jatav
Subject: Planning software deployment on heterogeneous and distributed infrastructures
Institution: IIT Bombay (India)

Vidya Lakshmi Rajagopalan
Subject: Dynamic vertical scaling of parallel applications in clouds
Institution: Vrije Universiteit, Amsterdam (Netherlands)

Ancuta Iordache
Subject: Elastic MapReduce in cloud federations
Institution: West Timisoara University (Romania)

8.4.4. Participation In International Programs

Christine Morin was involved in the Master school education action line to participate in the definition of the Distributed Systems and Services (DSS) major of the EIT ICT Labs Master in ICT innovation.

Since September 2011, Christine Morin has been an affiliate at Lawrence Berkeley National Laboratory working in the Advanced Computing for Science (ACS) department of the Computational Research Division (CRD). During her sabbatical visit at the Lawrence Berkeley National Laboratory, Christine Morin is in charge of the INRIA@SiliconValley program jointly with the INRIA international affairs department.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. PACAGRID Plateform

Program: CPER
Project acronym: PacaGrid
Project title: Contrat Plan État Région Grille et Calcul Pair-à-Pair
Duration: jan 2009 - dec 2011
Coordinator: INRIA Oasis
Other partners: Conseil Regional PACA
See also: http://proactive.inria.fr/pacagrid/
Abstract: This contract aims at building a regional computing platform. This is achieved by mixing desktop machines with dedicated ones like clusters. Users willing to submit a job will do so by accessing a web-page and uploading their program. It will then be scheduled and executed on a machine when available. A scheduler, a resource manager, and a web portal have been developed and are now operational.

In the first part of the project, the access to the platform was restricted to Inria members. Now that most of the tools have been developed, the access is open to industrial partners.

8.2. National Initiatives

8.2.1. ANR OMD2

Program: Cosinus
Project acronym: OMD2
Project title: Optimisation Multidisciplinaire
Duration: jan 2009 - jun 2012
Coordinator: Renault
Other partners: INRIA, ENSM-SE, UTC, ECP, IRCCyN, ENS CACHAN, CD-adapco, SIREHNA, ACTIVEEON, Digiteo (all french)
Abstract: The aim of this project is to define, develop and experiment a collaborative platform of multidisciplinary optimization - As "platform" we consider here a software environment hosting heterogeneous code and data, geographically distributed in equally heterogeneous machines. These codes can be sequential or parallel. These machines can be data servers, supercomputers, PC farms, etc. - As "collaborative" we consider this environment to be able to host, control and allow communication of these codes transparently for the user, according to their own work habits. - As "multidisciplinary optimization", we consider the collection of methods and numerical tools, objects of the other tasks in OMD2 and previously realized during project OMD. It has been decided that ProActive will be used as middleware for communication between machines, and that the ProActive Scheduler will be used as a basis for the collaborative platform. Similarly, Scilab will be used as a common language to describe optimization strategies.

8.2.2. ANR SocEDA
Program: Arpège
Project acronym: SocEDA
Project title: Plate-forme EDA sociale, largement distribuée pour l’informatique dans les nuages
Duration: nov. 2010 - oct. 2013
Coordinator: EBM WebSourcing
Other partners: ActiveEon, Ecole des Mines Albi, I3S CNRS (OASIS), CNRS/LIG (SARDES), INSA Lyon/LIRIS, France Telecom, INRIA Lille (ADAM), THALES communications.
See also: http://www.soceda.org
Abstract: The goal of SocEDA is to build a flexible, elastic and efficient platform for handling events generated by services deployed on top of federated and distributed enterprise service buses. To scale up and be highly configurable, the platform will be designed as a GCM based application built along Peer-to-peer principles for scalability and robustness, and deployed on Grid/Cloud hybrid environments. Publications/subscriptions will be organized along social links that may exist between the deployed services.

8.2.3. FUI CompatibleOne

Program: FUI
Project acronym: CompatibleOne
Project title: CompatibleOne
Duration: aug. 2010 - oct. 2013
Coordinator: Bull
Other partners: ActiveEon, Bull, CityPassenger, eNovance, INRIA, Institut Télécom, Mandriva, Nexedi, Nuxeo, OW2, Prologue, XWiki
See also: http://www.compatibleone.org/
Abstract: The competitiveness cluster Systematic, in Ile de France, has launched the Compatible One project, also labelled by the SCS cluster. The goal is to define an open solution for IaaS and PaaS. The CompatibleOne project identifies, aggregates and integrates leading open source technologies into a rich and comprehensive ‘cloudware’ stack. CompatibleOne is developing a meta-model-based framework for the abstraction of the configuration, management and integration of these technologies. This ’cloudware’ framework, based on open, common standards and leading open source technologies, will offer cloud builders the greatest possible interoperability.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. SOA4ALL
Title: Service Oriented Architectures for All
Type: COOPERATION (ICT)
Defi: Service & SA architectures, infrastructures and engineering
Instrument: Integrated Project (IP)
Duration: March 2008 - February 2011
Coordinator: Atos Origin (Spain)
Others partners: British Telecommunications (UK); The Open University (UK); SAP; CEFRIEL (It); STI - University of Innsbruck (At); EBM WebSourcing (Fr); Hanival Internet Services (At); Universität Karlsruhe (De); INRIA (Fr); iSOCO (Sp); Ontotext Lab (Bu); seekda (Au); TIE Nederland; TXT e-Solutions (It); The University of Manchester (Uk); Universidad de Sevilla (Es)
Abstract: Service Oriented Architectures for All (SOA4All) is a Large-Scale Integrating Project funded by the European Seventh Framework Programme, under the Service and Software Architectures, Infrastructures and Engineering research area.

SOA4All will help realize a world where billions of parties are exposing and consuming services via advanced Web technology: the main objective of the project is to provide a comprehensive framework and infrastructure that integrates complementary and evolutionary technical advances (i.e., SOA, context management, Web principles, Web 2.0 and Semantic Web) into a coherent and domain-independent service delivery platform.

8.3.1.2. PLAY

Title: Pushing dynamic and ubiquitous interaction between services Leveraged in the Future Internet by ApplYing complex event processing

Type: COOPERATION (ICT)

Defi: Internet of Services, Software & Virtualisation

Instrument: Specific Targeted Research Project (STREP)

Duration: October 2010 - September 2013

Coordinator: FZI (Germany)

Others partners: EBM WebSourcing (Fr), INRIA (OASIS and SARDES) (Fr), France Telecom (Fr), ICCS (Gr), Ecole des Mines Albi (Fr), CIM (Serbia).

Abstract: The PLAY project will develop and validate an elastic and reliable architecture for dynamic and complex, event-driven interaction in large highly distributed and heterogeneous service systems. Such an architecture will enable ubiquitous exchange of information between heterogeneous services, providing the possibilities to adapt and personalize their execution, resulting in the so-called situational-driven process adaptivity. The OASIS Team is in charge of designing the key element of the PLAY Platform: the event cloud that is a publish/subscribe P2P based system, developed using the GCM technology.

8.3.1.3. TEFIS

Title: TEstbed for Future Internet Services

Type: COOPERATION (ICT)

Defi: Future Internet Experimental Facility and Experimentally-driven Research

Instrument: Integrated Project (IP)

Duration: June 2010 - November 2012

Coordinator: THALES Services SAS (France)

Others partners: Engineering Ingegneria Informatica S.p.A. (It); IT Innovation (UK); Fundação de Apoio à Universidade de São Paulo (Br); Thales Communications (Fr); ActiveEon (Fr); Lulea University of Technology (Se); Software Quality System S.A. (Es); Fraunhofer Institute FOKUS (De)

See also: http://www.tefisproject.eu/

Abstract: TEstbed for Future Internet Services (TEFIS) is a Large-Scale Integrating Project funded by the European Seventh Framework Programme, under the ICT research area and, more precisely, around the theme of Future Internet Experimental Facility and Experimentally-driven Research. Internet is more and more used by services and applications as the common communication infrastructure. However, the Internet and Software industry is facing two main challenges. The
first one is that Internet is progressively reaching a saturation point in meeting an ever increasing variety of user expectations. The second one is that the increasing complexity of ICT environments (user communities, network heterogeneity, multiplicity of terminals and platforms) is paralysing testing processes for the assessment of Internet-based services at large-scale. Product and business developers must be able to rapidly satisfy and anticipate user requirements while testing and sizing their applications and services, being sure to constantly have the right amount of reactivity with regards to market demands.

To address these challenges, TEFIS will provide an open platform to enable the design, dimensioning and user-centric validation of innovative applications and services on top of upcoming Future Internet technologies. The TEFIS platform will be a central access point to heterogeneous and complementary experimental facilities addressing the full development lifecycle of innovative services with the appropriate tools and testing methodologies.

8.3.1.4. FI-WARE

Title: Future Internet Core Platform
Type: COOPERATION (ICT)
Defi: PPP FI: Technology Foundation: Future Internet Core Platform
Instrument: Integrated Project (IP)
Duration: May 2011 - April 2014
Coordinator: Telefonica (Spain)

Others partners: Alcatel-Lucent (De,It); Atos Origin (Sp); Deutsche Telecom (De); Engineering - Ingegneria Informatica (It); Ericsson (Se); France Telecom (Fr); Fraunhofer GFD (De); Angewandten Forschung (De); IBM Israel Science And Technology (Il,Ch); IBM Research (Is); INRIA (Fr); INTEL Performance Learning Solutions (Ir); NEC Europe (UK); Nokia Siemens Networks (Ge,Hu,Fi); SAP (Ge); SIEMENS (Ge); Telecom Italia (It); Thales Communications (Fr); Technicolor SNC (Fr); Universita Di Roma La Sapienza (It); Universitaet Duisburg-Essen (De); University of Surrey (UK); Universidad Politecnica De Madrid (Es)

See also: http://www.fi-ware.eu/

Abstract: The high-level goal of the FI-W ARE project is to build the Core Platform of the Future Internet, introducing an innovative infrastructure for cost-effective creation and delivery of versatile digital services, providing high QoS and security guarantees.

8.4. International Initiatives

8.4.1. Visits of International Scientists

8.4.1.1. Internship

We are hosting Ms Yanwen Chen, PhD student form East China Normal University (ECNU, Shanghai), for a 9 month visit funded by the INRIA Internship program, from 2011 nov. 15 to 2012 aug. 15. The thesis subject is “Formal Model and Scheduling Algorithms for Real-time CPS”.
8. Partnerships and Cooperations

8.1. Regional Initiatives

- **Assistive Technologies for Elderly**
  The objective of this project is to provide an open platform of digital assistance dedicated to aging in place. This project is in collaboration with researchers in Cognitive Science (Bordeaux University) and the UDCCAS Gironde (Union Départementale des Centres Communaux d’Action Sociale) managing elderly care. This project will include a need analysis, the development of new assistive applications and their experimental validation.

  This work is funded by CARSAT Aquitaine (“Caisse d’Assurance Retraite et de la Santé au Travail”).

- **Cognitive Assistance for Supporting the Autonomy of Persons with Intellectual Disabilities**
  The objective of this project is to develop assistive technologies enabling people with intellectual disabilities to gain independence and to develop self-determined behaviors, such as making choices and taking decisions. This project is in collaboration with the “Handicap et Système Nerveux” research group (EA 4136, Bordeaux University), the TSA Chair of UQTR (Université du Québec à Trois-Rivières) in Psychology and the Association Trisomie 21 Gironde (Down’s Syndrom). The TSA chair has recently designed and built a smart apartment that is used to conduct experimental evaluation of our assistive technologies in realistic conditions.

8.2. National Initiatives

- **SmartImmo: Towards intelligent and environmentally-friendly buildings**
  The SmartImmo project gathers research groups in pervasive systems and french companies working in the building construction, installation, and management. This project led by Orange Labs aims to make a building able to “communicate” with its occupants and to be environmentally-friendly (e.g., automatic temperature adjusting). The main objectives of this project are to design a M2M (Machine-To-Machine) box for the heterogeneous equipment communication and to build several services on top of this platform.

  This project is funded by the SCS (Secured Communicating Solutions), a french pole of competitiveness.

- **SERUS: Software Engineering for Resilient Ubiquitous Systems**
  The objectives of this project is to propose a design-driven development methodology for resilient systems that takes into account dependability concerns in the early stages, ensures the traceability of these requirements throughout the system life-cycle, even during runtime evolution. To provide a high level of support, this methodology will rely on a design paradigm dedicated to sense/compute/control applications. This design will be enriched with dependability requirements and used to provide support throughout the system life-cycle. This project is in collaboration with the TSF-LAAS research group (CNRS, Toulouse) and the ADAM research project-team (Inria Lille Nord Europe).

  This work is funded by the Inria collaboration program (in French, “actions de recherches collaboratives”).

- **School Inclusion for Children with Autism**
  The objective of this project is to provide children with assistive technologies dedicated to the school routines. This project is in collaboration with the “Handicap et Système Nerveux” research
group (EA 4136, Bordeaux University), the PsyCLÉ research center (EA 3273, Provence Aix-Marseille University) and the “Parole et Langage” research laboratory (CNRS, Provence Aix-Marseille University).

This work is funded by the French Ministry of National Education.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: SUDOE territorial cooperation program (Interreg IV B)
Project acronym: Biomasud
Project title: Mechanisms for sustainability and enhancement of solid biomass market in the space of SUDOE
Duration: July 2011 - June 2013
Coordinator: AVEBIOM
Other partners: UCE (Consumers Union of Spain), CIEMAT (Public Research Agency for excellence in energy and environment, Spain), CBE (Centro da Biomassa para a Energia, Portugal), CVR (Centro para la Valorización de Residuos, Portugal) and UCFF (Union Française de la Coopération Forestière, France)

Abstract: The goal of the Biomasud european project is to show the viability of the biomass-based energy model. The project aims to propose a certification and traceability process throughout the value chain of biofuel. Our objective is to design and implement a prototype of traceability system that will extract automatically traceability information based on sensors such as RFID tags, simplifying the certification process. This work will leverage our DIA SUITE development methodology and will be evaluated by the Biomasud partners.

8.3.2. Major European Organizations with which you have followed Collaborations

University of Copenhagen, DIKU (Denmark)
Subject: we have been exchanging visits and publishing articles with Julia Lawall

8.4. International Initiatives

8.4.1. Inria International Partners

- University of McGill, Montréal, Canada
- University of Québec, Trois-Rivières, Canada

8.4.2. Visits of International Scientists

The Phoenix group has been visited by:
- Scott Lee (University of Auckland, New Zealand) on April 27, 2011.
- Kay Connely (Indiana University, US) from October 6, 2011 to October 7, 2011.
- Dany Lussier-Desrochers (University of Québec, Trois-Rivières, Canada) from October 3, 2011 to October 7, 2011.
8. Partnerships and Cooperations

8.1. Regional Initiatives

PFT  (2011-2014) : DGCIS funded project, in the context of the competitivity cluster SCS, whose aim is to provide to PACA region industrials wishing to develop or validate new products related to future mobile networks and services and M2M application, a networking infrastructure and tools helpful for development, test and validation of those products. Other partners : 3Roam, Audilog Groupe Ericsson, Ericsson, Eurecom, Inria, iQsim, MobiSmart, Newsteo, OneAccess, Orange Labs, Pôle SCS, ST Ericsson, Telecom Valley. Our contribution is centred around providing a test methodology and tools for wireless networks experimentation.

8.2. National Initiatives

ANR FIT  (2011-2108): FIT (Future Internet of Things) aims to develop an experimental facility, a federated and competitive infrastructure with international visibility and a broad panel of customers. It will provide this facility with a set of complementary components that enable experimentation on innovative services for academic and industrial users. The project will give French Internet stakeholders a means to experiment on mobile wireless communications at the network and application layers thereby accelerating the design of advanced networking technologies for the Future Internet. FIT is one of 52 winning projects from the first wave of the French Ministry of Higher Education and Research’s “Équipements d’Excellence” (Equipex) research grant programme. The project will benefit from a 5.8 million euro grant from the French government. Other partners are UPMC, IT, Strasbourg University and CNRS. See also http://fit-equipex.fr/ .

ANR ARESA2  (2009-2012): The Planète team is involved in the ARESA2 project which aims at advancing the state of the art in Secure, Self-Organizing, Internet?Connected, Wireless Sensor and Actuator Networks (WSANs). These challenges are to be addressed in an energy-efficient way while sticking to memory-usage constraints. The partners are INRIA, CEA-LETI, France Telecom R&D, Coronis Systems, LIG/Drakkar, Verimag and TELECOM Bretagne.

ANR pFlower  (2010-2013): Parallel Flow Recognition with Multi-Core Processor. The main objective of this project is to take advantage of powerful parallelism of multi-thread, multi-core processors, to explore the parallel architecture of pipelined-based flow recognition, parallel signature matching algorithms. The project involves INRIA (planete), Université de Savoie, and ICT/CAS (China).

Inria Mobilitics  (2011-2012): as a joint national project with CNIL (the French national committee of Information freedom ). Platform for mobile devices privacy evaluation. This project strives to deploy an experimental mobile platform for studying and analyzing the weaknesses of current online (smartphone) applications and operating systems and the privacy implications for end-users. For instance, one of the objectives is to understand trends and patterns collected when they are aimed at obtaining general knowledge that does not pertain to any specific individual. Examples of such tasks include learning of commuting patterns, inference of recommendation rules, and creation of advertising segments.

Collaborative Action CAPRIS  (2011-2014): the Collaborative Action on the Protection of Privacy Rights in the Information Society (CAPRIS), is an Inria national project, which goal is to tackle privacy-related challenges and provide solutions to enhance the privacy protection in the Information Society. His main tasks are the identification of existing and future threats to privacy, and the design of appropriate measures to assess and quantify privacy.
ANR CMON (2009-2012) : This project involves, in addition to INRIA, Technicolor Paris Lab, LIP6, ENS and the Grenouille.com association. CMON stands for collaborative monitoring. It is an industrial research project that develops the technology needed to allow end-users to collaborate in order to identify the origin and cause of Internet service degradation. The main differentiating assumptions made in this project are that (i) ISPs do not cooperate together, and (ii) one cannot rely on any information they provide in order to diagnose service problems. Even more, CMON considers that these ISP will try to masquerade the user observations in order to make their service look better. The software designed in this project will be added to the toolbox currently provided by the Grenouille architecture. The hope is that such a project will encourage ISPs to improve their quality of service and will contribute to improve customer satisfaction.

See also http://wiki.grenouille.com/index.php/CMON.

ANR F-Lab (2011-2013): ANR funded project on the federation of computation, storage and network resources, belonging to autonomous organizations operating heterogeneous testbeds (e.g. PlanetLab testbeds and Sensors testbeds). This includes defining terminology, establishing universal design principles, and identifying candidate federation strategies. Other partners: UPMC, A-LBLF and Thales.

ANR Connect (2011-2012): ANR funded project on content centric Networking architecture. The aim is to propose adequate naming, routing, cache management and transmission control schemes for CCN based networks. Our contribution is centered on network traffic characterization video streaming and on the integration of the CCNx code in the ns-3 simulator. Other partners: UPMC, Alcatel Lucent, Orange R&D, IT.

ANR SCATTER (2011-2012): ANR funded project on Scalable Naming in Information Centric Networks. The goal of this activity is to evaluate the scalability of state of the art naming schemes both from the name resolution and routing points of view. The four main approaches that will be considered are: Content Centric Networking (CCN), Publish-Subscribe Internet Routing Paradigm (PSIRP), Network of Information (NetInf) and Data-Oriented Network Architecture (DONA). Other French partners: UPMC. International KIC partner: SICS.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. ECODE

Title: Experimental COgnitive Distributed Engine
Type: COOPERATION (ICT)
Defi: New paradigms and experimental facilities
Instrument: Specific Targeted Research Project (STREP)
Duration: September 2008 - August 2011
Coordinator: Alcatel Lucent (Belgium)
Others partners: UCL (Belgium), ULg (Belgium), IBBT (Belgium), ULANC (UK), CNRS (France).

See also: http://www.ecode-project.eu/

Abstract: The goal of the ECODE project is to develop, implement, and validate experimentally a cognitive routing system that can meet the challenges experienced by the Internet in terms of manageability and security, availability and accountability, as well as routing system scalability and quality. By combining both networking and machine learning research fields, the resulting cognitive routing system fundamentally revisits the capabilities of the Internet networking layer so as to address these challenges altogether. For this purpose, the project investigates and elaborates novel
semi-supervised, on line, and distributed machine learning techniques kernel of the cognitive routing system. During the building phase, the cognitive routing system is both designed and prototyped. In the second phase, three sets of use cases are experimented to evaluate the benefits of the developed machine learning techniques. The experimentation and the validation of these techniques are carried out on physical (iLAB) and virtual (e.g., OneLab) experimental facilities.

8.3.1.2. NOVI

Title: Networking innovations Over Virtualized Infrastructures
Type: COOPERATION (ICT)
Defi: CAPACITIES programme.
Instrument: Specific Targeted Research Project (STREP)
Duration: September 2010 - February 2013
Coordinator: NTUA (Greece)
Others partners: 13 european partners including GARR, ELTE, Cisco, etc.
See also: http://www.fp7-novi.eu/
Abstract: NOVI (Networking innovations Over Virtualized Infrastructures) research concentrates on efficient approaches to compose virtualized e-Infrastructures towards a holistic Future Internet (FI) cloud service. Resources belonging to various levels, i.e. networking, storage and processing are in principle managed by separate yet interworking providers. NOVI will concentrate on methods, information systems and algorithms that will enable users with composite isolated slices, baskets of resources and services provided by federated infrastructures.

8.3.1.3. OPENLAB

Title: OpenLab: extending FIRE testbeds and tools
Type: COOPERATION (ICT)
Defi: ICT 2011.1.6 Future Internet Research and Experimentation (FIRE)
Instrument: Integrated Project (IP)
Duration: September 2011 - January 2014
Coordinator: Université Pierre et Marie Curie (France)
Others partners: 18 European partners (including ETH Zurich, Fraunhofer, IBBT, TUB, UAM, etc.) and Nicta from Australia.
See also: http://www.ict-openlab.eu/
Abstract: OpenLab brings together the essential ingredients for an open, general purpose and sustainable large scale shared experimental facility, providing advances to the early and successful prototypes serving the demands of Future Internet Research and Experimentation. OpenLab partners are deploying the software and tools that allow these advanced testbeds to support a diverse set of applications and protocols in more efficient and flexible ways. OpenLab’s contribution to a portfolio that includes: PlanetLab Europe (PLE), with its over 200 partner/user institutions across Europe; the NITOS and w-iLab1 wireless testbeds; two IMS telco testbeds that can connect to the public PSTN, to IP phone services, and can explore merged media distribution; an LTE cellular wireless testbed; the ETOMIC high precision network measurement testbed; the HEN emulation testbed; and the ns-3 simulation environment. Potential experiments that can be performed over the available infrastructure go beyond what can be tested on the current internet. OpenLab extends the facilities with advanced capabilities in the area of mobility, wireless, monitoring, domain interconnections and introduces new technologies such as OpenFlow. These enhancements are transparent to existing users of each facility. Finally, OpenLab will finance and work with users who propose innovative experiments using its technologies and testbeds, via the open call mechanism developed for FIRE facilities.
8.3.1.4. WSN4CIP

Title: Wireless Sensor Networks for critical infrastructures Protection
Type: COOPERATION (ICT)
Defi: FP7 Security area, Objective 1.7 Critical Infrastructure Protection
Instrument: Specific Targeted Research Project (STREP)
Duration: 2009 - 2011
Coordinator: Eurescom (Germany)
Others partners: 11 European partners (including IHP, NEC, BUTE, etc.)
See also: http://www.wsan4cip.eu/home.html

Abstract: The goal of WSAN4CIP is to advance the technology of Wireless Sensor and Actuator Networks (WSANs) beyond the current state of the art, in order to improve the protection of Critical Infrastructures (CIs). By advancing WSAN technology, the project contributes to networked information and process control systems which are more secure and resilient. The distributed nature of WSANs enables them to survive malicious attacks as well as accidents and operational failures. It makes them dependable in critical situations, when information is needed to prevent further damage to CIs.

8.3.2. EIT KIC funded activities

Our project team was involved in 2011 in two activities funded by the EIT ICT Labs KIC: FITTING on Future InterneT (of ThINGs) facility and Information centric and device clouds (11901). In 2012, we will be involved in three additional activities on Software-Defined Networking (SDN) (11634), Information-centric networking (ICN) experimentation (12191) and Seamless P2P video streaming for the web (12199). The FITTING activity is mentioned as a “success story” by the EIT ICT Labs KIC. In fact, after an initial funding in 2010, the french partners succeeded to get the FIT Equipment of Excellence project accepted with a total budget of 5.8 MEuros to develop a testbed federation in France.

8.3.2.1. FITTING

Title: Future InterneT (of ThINGs) facility
Activity Number: 10340
Duration: 2011-2012
Coordinator: UPMC (France)
Others partners: Alcatel Lucent, Fraunhofer FOKUS, BME, IT, U. Paris XI.

Abstract: FITTING develops a testbed federation architecture that combines wireless and wired networks. Through FITTING, components and solutions developed in the projects OneLab2, PII and SensLAB are brought together to facilitate access. These components and devices complement each other – for instance SensLAB enhances the testbed federation by adding wireless sensors. FITTING addresses issues related to usability and accessibility of federated experimentation resources from multiple autonomous organizations. FITTING is a process of federating elements from various European and national initiatives into a global shared resource pool with a standardized interface to access them. Further, FITTING will adopt a user-driven (researchers, developers, students) approach with its running testbeds allowing experimentation with different technologies to meet the variety of needs of a broad customer base.

8.4. International Initiatives

8.4.1. INRIA Associate Teams

COMMUNITY Associated team (2009-2011): Planète is an associated team with the UC Santa Cruz’s Jack Baskin School of Engineering. The collaborative project is about communication in heterogeneous networks prone to episodic connectivity, see URL http://inrg.cse.ucsc.edu/community/. Our initial scientific objective throughout the project was to design efficient message delivery mechanisms for challenged and heterogeneous networks, and targeted:

- The design of a unifying solution to enable message delivery over heterogeneous networks with varying degrees of connectivity.
- The design of error- and congestion control techniques in episodically connected networks.
- The exploration of different mechanisms for quality-of-service (QoS) support in such environments.

We have re-oriented some of the initial proposed research. In particular, rather than investigating error and congestion control techniques for DTNs, we focused on the development of efficient routing strategies that take into account the utility of nodes to relay messages. Furthermore, we developed a naming scheme that supports message delivery over heterogeneous networks prone to connectivity disruptions, see further details in Section 1.

8.4.2. Visits of International Scientists

Luigi Alfredo Grieco, Visiting Professor (one week in December 2011)

Subject: On Evaluating Fairness in Content Centric Networks
Institution: University of Bari (Italy)

Katia Braczka, Visiting Professor (one week in January 2011 and one week in November 2011)

Subject: Communication in Heterogeneous Networks Prone to Episodic Connectivity
Institution: University of California at Santa Cruz (United States)

Marc Mendonca, Visiting PhD student (from Sep 2011 until Dec 2011)

Subject: Efficient Communication Mechanisms for Episodically Connected and Heterogeneous Networks
Institution: University of California at Santa Cruz (United States)

8.4.3. Visits to International teams

Thierry Turletti, Visiting researcher to University of California at Santa Cruz (one week in June 2011)

Subject: Efficient Communication Mechanisms for Episodically Connected and Heterogeneous Networks

8.4.4. Participation In International Programs

- WELCOME (STIC AmSud): This project (2010-2011) aims to design realistic models of the physical layer in order to be used in both simulations and experimentation of wireless protocols. In addition to the Planète Project-Team, the partners are Universidad de Valparaiso, Chile, Universidad de Córdoba, Argentina and Universidad Diego Portales, Chile.

- CIRIC: Our project-team was involved in the definition of the topics for the Network and Telecom R&D line of the (the Communication and Information Research and Innovation Center - CIRIC), the Inria research and innovation centre in Chili. In this context, we will extend our collaboration with Universidad Diego Portales, Chile.
7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. DECARTE

Participants: Nathalie Mitton [correspondant], David Simplot-Ryl.

Title: Developpement de Carton électronique
Type: FUI
Duration: November 2008 - June 2012
Coordinator: Cartonneries de Gondardennes

Others partners: ___Inria POPS___ ___IEMN___ ___CTP___ ___Cascades___ ___IER___ ___TagSys___

Abstract: ___DECARTE studies the printing of an UHF RFID tag on packaging in order to reduce manufacturing costs.___

7.1.2. IDC

Participants: Roudy Dagher, Michael Hauspie [correspondant], Nathalie Mitton, David Simplot-Ryl.

Title: Intelligent Data Center
Type: IPER
Duration: November 2010 - June 2012
Coordinator: NooliTic

Others partners: ___Inria POPS___ ___CIV___

Abstract: ___IDC studies wireless sensor network based solution to optimize the server monitoring in data centers. ___

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. SensLAB

Participants: Nathalie Mitton [correspondant], Loic Schmidt, David Simplot-Ryl, Julien Vandesael.

Title: Project Very large scale open wireless sensor network testbed
Type: TLCOM
Duration: December 2007 - December 2011
Coordinator: Inria DNET (Lyon)

Others partners: ___Inria POPS and ASAP___ ___Thales___ ___UPMC___ ___Université de Strasbourg___

See also: ___http://www.senslab.info/___
Abstract: ___SensLAB is a group of 1K sensor nodes available as a testbed for distributed embedding sensor network application and distributed systems research. Distributed systems based on networked sensors and actuators with embedded computation capabilities allow for an instrumentation of the physical world at an unprecedented scale and density, thus enabling a new generation of monitoring and control applications. The SensLAB project was started in 2008. As of June 2009, SensLAB was composed of 1024 nodes at 4 sites. Accounts are available to persons affiliated with corporations and universities that host SensLAB nodes but also to any researchers for R&D purpose on request. SensLAB members actively participate in developing tools for the greater good of the community, and as a result each user has a wide choice of tools to use in order to design, compile, simulate, emulate, debug his/her embedded sensor application. There are a number of free, public services / tools / package have been deployed on SensLAB, including drivers, OS portage, network simulator (WSNET) and a software-driven simulator for full platform estimations and debug (WSIM). SensLAB forms the core of the an emerging testbed for the future internet of things technologies. ___

7.2.1.2. RESCUE
Participants: Milan Erdelj, Nathalie Mitton, Karen Miranda, Tahiry Razafindralambo [correspondant], David Simplot-Ryl.

Title: Reseau Coordonne de substitution mobile
Type: VERSO
Duration: December 2010 - December 2013
Coordinator: Inria POPS
Others partners: ___LAAS___ ___UPMC___ ___France Telecom___ ___ENS Lyon___
See also: ___ http://rescue.lille.inria.fr/ ___

Abstract: ___In RESCUE, we propose to exploit the controlled mobility of mobile routers to help a base network in trouble provide a better service. The base network may be any access network or metropolitan network (including wired and wireless technologies). Troubles may come from an increase of unplanned traffic, a failure of an equipment, or a power outage.

When no backup networks are available, it would be interesting to deploy, for a limited time corresponding to the period of the problem (i.e., failure or traffic overload), a substitution network to help the base network keep providing services to users. In the RESCUE project, we will investigate both the underlying mechanisms and the deployment of a substitution network composed of a fleet of dirigible wireless mobile routers. Unlike many projects and other scientific works that consider mobility as a drawback, in RESCUE we use the controlled mobility of the substitution network to help the base network reduce contention or to create an alternative network in case of failure. ___

7.2.1.3. WINGS
Participants: Nathalie Mitton [correspondant], Roberto Quilez, David Simplot-Ryl.

Title: Widening Interoperability for Networking Global Supply Chains
Type: VERSO
Duration: November 2009 - March 2012
Coordinator: GS1
Others partners: ___Inria POPS___ ___UPMC___ ___France Telecom___ ___AFNIC___ ___GR-EYC___
See also: ___ http://www.wings-project.fr/ ___

Abstract: ___This 2-year project focus on a proof-of-concept platform demonstrating the federated ONS model and the interaction with a prototype of Discovery Service. ___
7.2.1.4. F-Lab

**Participants**: Nathalie Mitton [correspondant], Priyanka Rawat, Tahiry Razafindralambo, David Simplot-Ryl.

Title: Federating Computing Resources
Type: VERSO
Duration: November 2010 - November 2013
Coordinator: UPMC
Others partners: ___Inria DNet, Planete, POPS___ ___Thales___ ___ALU___
See also: ___ http://f-lab.fr/ ___

Abstract: The F-Lab project works towards enabling an open, general-purpose and sustainable large-scale shared experimental facility that fosters the emergence of the Future Internet. F-Lab builds on a leading prototype for such a facility: the OneLab federation of testbeds. F-Lab will enhance the OneLab federation model with the addition of SensLAB’s unique sensor network and LTE-based cellular systems, and develop tools to conduct experiments on these enriched facilities. Project partners include some of France’s top academic and industrial research institutions, working together to develop experimental facilities on the Future Internet. F-Lab presents an unique opportunity for the French community to play a stronger role in the design of federation systems; for the SensLAB testbed to reach an international visibility and use; and for the pioneering of testbeds based on LTE technology. ___

7.2.1.5. BinThatThinks

**Participants**: Tony Ducrocq, Michael Hauspie, Nathalie Mitton [correspondant], David Simplot-Ryl.

Title: BinThatThinks
Type: ECOTECH
Duration: November 2010 - November 2013
Coordinator: Inria ACES (Rennes)
Others partners: ___Etineo___ ___Veolia___
See also: ___ http://binthatthink.inria.fr/ ___

Abstract: Efficient dust sorting is a main challenge for the current society. BinThatThinks is a research project that aims to propose a system that makes the collect and sorting easier through the use of RFID and sensors. ___

7.2.2. ARC

7.2.2.1. MISSION

**Participants**: Milan Erdelj, Nathalie Mitton, Enrico Natalizio, Tahiry Razafindralambo [correspondant], David Simplot-Ryl.

Title: Mobile Substitution Networks
Type: ARC
Duration: January 2010 - December 2011
Coordinator: Inria POPS
Others partners: ___Inria Reso___ ___UPMC___
See also: ___ http://arcmission.lille.inria.fr/ ___

Abstract: In MISSION, we study the feasibility of the set up of a substitution network by using mobile robots equipped with one or several wireless technologies. More precisely, the focus is be put on the deployment and re-deployment of robots based on QoS constraints. ___
7.2.3. ADT

7.2.3.1. SenSas

**Participants:** Nathalie Mitton [correspondant], Lucie Jacquelin, Tahiry Razafindralambo, Julien Vandaele.

Title: Sensor Network Applications  
Type: ADT  
Duration: November 2010 - November 2014  
Coordinator: Inria POPS  
Others partners: Inria Non-A, Inria D-NET, Inria Planete, Inria NECS, Inria DEMAR, Inria MADDYSES, Inria AMAZONE, Inria SED  
See also: http://sensas.gforge.inria.fr/  
Abstract: SenSas aims to propose mainly control science application based on wireless sensor and actuator network nodes provided from the work done around senslab and sens tools projects.

7.2.3.2. SensLille

**Participants:** Victor Corblin, Nathalie Mitton [correspondant], Loic Schmidt, Julien Vandaele.

Title: SensLille  
Type: ADT  
Duration: November 2011 - November 2013  
Coordinator: Inria POPS  
Abstract: SensLille is an ADT that aims to improve SensLab Lille platform by offering new functionalities as the use of electric trains to experiment mobile nodes.

7.2.4. Equipements d’Excellence

7.2.4.1. FIT

**Participants:** Nathalie Mitton [correspondant], Tahiry Razafindralambo, Loic Schmidt, Julien Vandaele.

Title: Future Internet of Things  
Type: EquipEx  
Duration: March 2010 - December 2019  
Coordinator: UPMC  
See also: http://fit-equipex.fr/  
Abstract: FIT (Future Internet of Things) aims to develop an experimental facility, a federated and competitive infrastructure with international visibility and a broad panel of customers. It will provide this facility with a set of complementary components that enable experimentation on innovative services for academic and industrial users. The project will give French Internet stakeholders a means to experiment on mobile wireless communications at the network and application layers thereby accelerating the design of advanced networking technologies for the Future Internet.  
FIT is one of 52 winning projects from the first wave of the French Ministry of Higher Education and Research’s "Equipements d’Excellence" (Equipex) research grant program. Coordinated by Professor Serge Fdida of UPMC Sorbonne Universités and running over a nine-year period, the project will benefit from a 5.8 million euro grant from the French government.
7.3. European Initiatives

7.3.1. FP7 Projet

7.3.1.1. SECURE CHANGE

Participants: Arnaud Fontaine, Isabelle Simplot-Ryl [correspondant].

Title: Security Engineering for lifelong Evolvable Systems (SecureChange)
Type: COOPERATION (ICT)
Defi: ICT forever yours
Instrument: Integrated Project (IP)
Duration: February 2009 - February 2012
Coordinator: Università degli Studi di Trento (Italy)

Others partners: Budapest University of Technology and Economics Hungary
Gemalto France
Katholieke Universiteit Leuven Belgium
Smartesting France
Open University UK
Stiftelsen for industriell og teknisk forskning ved Norges Tekniske Hogskole Norway
Thales France
Telefonica Investigacion y Desarrollo Sociedad Anonima Unipersonal Spain
University of Innsbruck Austria
Deep Blue Italy
Technische Universität Dortmund Germany

See also: http://www.securechange.eu/

Abstract: Software-based systems are becoming increasingly long-living. This was demonstrated strikingly with the occurrence of the year 2000 bug, which occurred because software had been in use for far longer than its expected lifespan. At the same time, software-based systems are getting increasingly security-critical since software now pervades the whole critical infrastructures dealing with critical data of both nations and also private individuals. There is therefore a growing demand for more assurance and more verified security properties of IT systems both during development and at deployment time, in particular also for long living systems. Yet a long lived system also needs to be flexible, to adapt to changes and adjust to evolving requirements, usage and attack models. However, using today’s system engineering techniques we are forced to trade flexibility for assurance or vice versa.

7.3.1.2. ASPIRE

Participants: Nathalie Mitton [correspondant], Loic Schmidt, Lei Zhang, David Simplot-Ryl.

Title: Advanced Sensors and lightweight Programmable middleware for Innovative Rfid Enterprise applications (Aspire)
Type: COOPERATION (ICT)
Instrument: Integrated Project (IP)
Duration: January 2008 - June 2011
Coordinator: Aalborg University (Denmark) (Italy)

Others partners: Université Joseph Fourrier - Grenoble University - LIG Laboratory France
Athens Information Technology Greece
Melexis technologies SA Switzerland
Open Source Innovation Ltd UK
UEAPME European Office of Crafts, Trades and SMEs for Standardisation Belgium
SENS@P Greece
Pole Traceability Valence France
Instituto Telecomunicacoes Portugal

See also: http://www.fp7-aspire.eu/
Abstract: ___ASPIRE Project (Advanced Sensors and lightweight Programmable middleware for Innovative RFID Enterprise applications) will change the current RFID deployment paradigm, through introducing and boosting a shift towards royalty-free RFID middleware, while also placing the middleware at the heart of RFID infrastructures. In this paradigm a great deal of an RFID’s solution intelligence is place on the middleware, which is freely offered to end-users (particularly SMEs). Accordingly, the RFID middleware can integrate with low-cost hardware, as well as with legacy IT and networking infrastructures of the networked enterprise. To support this paradigm ASPIRE will develop and deliver a lightweight, royalty-free, programmable, privacy-friendly, standards-compliant, scalable, integrated and intelligent middleware platform that will facilitate low-cost development and deployment of innovative fully automatic RFID solutions. The above attributes of this middleware platform can be analyzed as follows: (i) Lightweight, (ii) Programmable, (iii) Intelligent, (iv) Standards-Compliant, (v) Scalable, (vi) Privacy-Friendly, (vii) Integrated. ASPIRE will research and provide a radical change in the current RFID deployment paradigm through innovative, programmable, royalty-free, lightweight and privacy friendly middleware. This new middleware paradigm will be particular beneficial to European SME, which are nowadays experiencing significant cost-barriers to RFID deployment ___

7.3.2. Collaborations in European Programs, except FP7

7.3.2.1. EGO

Participants: Gilles Grimaud [correspondent], Michael Hauspie, Francois Serman.

Program: EUREKA CATRENE
Project acronym: EGO
Project title: EGO
Duration: 2010 - 2013
Coordinator: Gemalto (France)

Other partners: Atos Worldline (France), Cork Institute of Technologie (Ireland), Continental Automotive (France), IDEX (Norway), Decawave (Ireland), Precise Biometrics (Sweden), STMicroelectronics (France), Tyndall (Ireland)

Abstract: The eGo project offers an innovative way to establish wireless bidirectional channels of communication between objects and users. Using signal transmission via the user’s body, every eGo-compliant object you touch is “paired” with the eGo device you carry on you, close to your skin. The objective is to enable very intuitive, very simple applications where touching a device turns into a personalization of such a device to install, for example, the user’s rights and credentials. "what you touch is yours". eGo offers a vast horizon of new intuitive applications, making user interfaces as simple as possible. eGo will be prototyped, integrated in several form factors in miniaturized system (System In Package) for new sensors, new batteries, ultra low-power transmitters for intrabody communication (via a natural connector: human skin), a highly secure micro controller comparable to those embedded in smart cards, a large data storage capacity and a high performance, high-speed wireless (Ultra Wide Band) transmitters. Embedded software, including JavaCard technology and secure remote management (Trusted Service Management) for managing services will also be integrated. This web site presents multiple use cases where eGo can add value.

See also: ___ http://www.ego-project.eu/ ___
6. Partnerships and Cooperations

6.1. PhD Grants

PhD grant CJS (Contrat Jeune Scientifique) Frontières du vivant of INRA for Emanuele Leoncini.

6.2. Visiting scientists

RAP team has received the following people:

- Thomas Bonald (Telecom ParisTech, Paris)
- Raluca Indre (Orange Labs)
- Davide Cuda (Orange Labs)
- Jonathan Touboul (INRIA, GANG)
- Amandine Véber (CMAP, École Polytechnique)
- Fabien Mathieu (INRIA BANG)
- Urtzi Ayesta (BCAM, Bilbao, Spain)
- Maaike Verloop (BCAM, Bilbao, Spain)
- Philippe Chassaing (Institut Élie Cartan, Université Henri Poincaré, Nancy)
- Nicolas Gast (EPFL)
- Irina Ignatiouk (Université de Cergy-Pontoise)
- Justin Salez (INRIA, TREC)
- Amar Prakash Azad (UC Santa Cruz, USA)
7. Partnerships and Cooperations

7.1. National initiatives

7.1.1. ODISEA2 - (2011–2014)

- **Members:** Orange, LIP6 (Regal), UbiStorage, Technicolor, Institut Telecom
- **Funding:** FUI project, Ile de France Region
- **Objectives:** ODISEA aims at designing new on-line data storage and data sharing solutions. Current solutions rely on big data centers, which induce many drawbacks: (i) a high cost, (ii) proprietary solutions, (iii) inefficiency (one single location, not necessarily close to the user). The goal is to tackle these issues by designing a distributed/decentralized solution that leverage edge resources like set-top boxes.
- It involves a grant of 159 000 euros from Region Ile de France over three years.


- **Members:** INRIA Rhones-Alpes (SARDES), LIP6 (REGAL), EMN, WeAreCloud, Elastic Cloud
- **Funding:** MyCloud project is funded by ANR Arpège
- **Objectives:** Cloud Computing is a paradigm for enabling remote, on-demand access to a set of configurable computing resources. The objective of the MyCloud project is to define and implement a novel cloud model: SLAaaS (SLA aware Service). Novel models, control laws, distributed algorithms and languages will be proposed for automated provisioning, configuration and deployment of cloud services to meet SLA requirements, while tackling scalability and dynamics issues. The principal investigators for Regal are Luciana Arantes, Pierre Sens, and Julien Sopena. It involves a grant of 155 000 euros from ANR to LIP6 over three years.

7.1.3. ConcoRDanT - (2010–2013)

- **Members:** INRIA Regal, project leader; LORIA, Universidade Nova de Lisboa
- **Funding:** PROSE project is funded by ANR Blanc
- **Objectives:** CRDTs for consistency without concurrency control in Cloud and Peer-To-Peer systems

Massive computing systems and their applications suffer from a fundamental tension between scalability and data consistency. Avoiding the synchronisation bottleneck requires highly skilled programmers, makes applications complex and brittle, and is error-prone. The ConcoRDanT project investigates a promising new approach that is simple, scales indefinitely, and provably ensures eventual consistency. A Commutative Replicated Data Type (CRDT) is a data type where all concurrent operations commute. If all replicas execute all operations, they converge; no complex concurrency control is required. We have shown in the past that CRDTs can replace existing techniques in a number of tasks where distributed users can update concurrently, such as co-operative editing, wikis, and version control. However CRDTs are not a universal solution and raise their own issues (e.g., growth of meta-data). The ConcoRDanT project engages in a systematic and principled study of CRDTs, to discover their power and limitations, both theoretical and practical. Its outcome will be a body of knowledge about CRDTs and a library of CRDT designs, and applications using them. We are hopeful that significant distributed applications can be designed using CRDTs, a radical simplification of software, elegantly reconciling scalability and consistency. The project leader and principal investigator for Regal is Marc Shapiro. ConcoRDanT involves a grant of 192 637 euros from ANR to INRIA over three years.
7.1.4. STREAMS - (2010–2013)

Members: LORIA (Score, Cassis), INRIA (Regal, ASAP), Xwiki
Funding: STREAMS is funded by ANR Arpège

Objectives: Solutions for a peer-To-peer REAL-tiMe Social web The STREAMS project proposes to design peer-to-peer solutions that offer underlying services required by real-time social web applications and that eliminate the disadvantages of centralised architectures. These solutions are meant to replace a central authority-based collaboration with a distributed collaboration that offers support for decentralisation of services. The project aims to advance the state of the art on peer-to-peer networks for social and real-time applications. Scalability is generally considered as an inherent characteristic of peer-to-peer systems. It is traditionally achieved using replication techniques. Unfortunately, the current state of the art in peer-to-peer networks does not address replication of continuously updated content due to real-time user changes. Moreover, there exists a tension between sharing data with friends in a social network deployed in an open peer-to-peer network and ensuring privacy. One of the most challenging issues in social applications is how to balance collaboration with access control to shared objects. Interaction is aimed at making shared objects available to all who need them, whereas access control seeks to ensure this availability only to users with proper authorisation. STREAMS project aims at providing theoretical solutions to these challenges as well as practical experimentation. The principal investigators for Regal is Marc Shapiro. It involves a grant of 57 000 euros from ANR to INRIA over three years.

7.1.5. PROSE - (2009–2011)

Members: Technicolor, INRIA (Regal), EURECOM, PLAYADZ, LIAFA
Funding: PROSE project is funded by ANR VERSO

Objectives: Content Shared Through Peer-to-Peer Recommendation & Opportunistic Social Environment

The Prose project is a collective effort to design opportunistic contact sharing schemes, and characterizes the environmental conditions as well as algorithmic and architecture principles that let them operate. The partners of the Prose project will engage in this exploration through various expertise: network measurement, system design, behavioral study, analysis of distributed algorithms, theory of dynamic graph, networking modeling, and performance evaluation.

The principal investigators for Regal are Sébastien Monnet and Marc Shapiro. It involves a grant of 152 000 euros from ANR to INRIA over three years.

7.1.6. ABL - (2009–2012)

Members: Gilles Muller, Gaël Thomas, Julia Lawall, Saha Suman
Funding: ANR Blanc

Objectives: The goal of the “A Bug’s Life” (ABL) project is to develop a comprehensive solution to the problem of finding bugs in API usage in open source infrastructure software. The ABL project has grown out of our experience in using the Coccinelle code matching and transformation tool, which we have developed as part of the former ANR project Blanc Coccinelle, and our interactions with the Linux community. Coccinelle targets the problem of documenting and automating collateral evolutions in C code, specifically Linux code. A collateral evolution is a change that is needed in the clients of an API when the API changes in some way that affects its interface. Coccinelle provides a language for expressing collateral evolutions by means of Semantic Patches, and a transformation tool for performing them automatically.

We have used Coccinelle to reproduce over 60 collateral evolutions in recent versions of Linux, affecting almost 6000 files. Recently, we have begun using Coccinelle to generate traditional patches for improving the safety of Linux. Over 800 of these patches developed using Coccinelle have been
integrated into the mainline Linux kernel. Julia Lawall was among the top 10 in terms of the number of contributed patches in Linux 2.6.36. Finally, about 20 semantic patches are integrated into the Linux sources so that developers can improve the quality of their programs by running Coccinelle as part of the development process.

In the ABL project, we are building on the results of Coccinelle by 1) designing libraries of semantic patches to identify API protocols and detect violations in their usage, 2) extending Coccinelle to address the needs of bug finding and reporting, and 3) designing complementary tools to help the programmer to track and fix bugs.

7.1.7. SHAMAN - (2009–2011)

Members: LIP6 (NPA), Inria Saclay (Grand-Large), Inria Bretagne (ASAP), LIP6 (Regal)

Funding: SHAMAN project is funded by ANR TELECOM

Objectives: Large-scale networks (e.g. sensor networks, peer-to-peer networks) typically include several thousands (or even hundred thousand) basic elements (computers, processors) endowed with communication capabilities (low power radio, dedicated fast network, Internet). Because of the large number of involved components, these systems are particularly vulnerable to occurrences of failures or attacks (permanent, transient, intermittent). Our focus in this project is to enable the sustainability of autonomous network functionalities in spite of component failures (lack of power, physical damage, software or environmental interference, etc.) or system evolution (changes in topology, alternation of needs or capacities). We emphasize the self-organization, fault-tolerance, and resource saving properties of the potential solutions. In this project, we will consider two different kinds of large-scale systems: on one hand sensor networks, and on the other hand peer to peer networks.


Members: MIS, LASMEA, GREYC, LIP6 (Regal), Thales

Funding: R-DISCOVER project is funded by ANR CONTINT

Objectives: This project considers a set of sensors and mobile robots arbitrarily deployed in a geographical area. Sensors are static. The robots can move and observe the positions of other robots and sensors in the plane and based on these observations they perform some local computations. This project addresses the problem of topological and cooperative navigation of robots in such complex systems.

7.1.9. PACTOL - (2009–2011)

Members: LIP6 (NPA, Regal), CNAM

Funding: Ile de France Region

Objectives: The scope of PACTOL is to propose verification tools for self-stabilizing distributed algorithms.

7.2. European Initiatives

7.2.1. Google European Doctoral Fellowship “A principled approach to eventual consistency based on CRDTs

Cloud computing systems suffer from a fundamental tension between scalability and data consistency. Avoiding the synchronisation bottleneck requires highly skilled programmers, makes applications complex and brittle, and is error-prone. The Commutative Replicated Data Type (CRDT) approach, based on commutativity, is a simple and principled solution to this conundrum; however, only a handful of CRDTs are known, and CRDTs are not a universal solution. This PhD research aims to expand our knowledge of CRDTs, to design and implement a re-usable library of composable CRDTs, to maintain study techniques for maintaining strong
invariants above CRDTs, and to experiment with CRDTs in applications. We are hopeful that significant distributed applications can be designed using our techniques, which would radically simplify the design of cloud software, reconciling scalability and consistency. This Google European Doctoral Fellowship is awarded to Marek Zawirski, advised by Marc Shapiro. This award includes a grant of 41 000 euros yearly over three years starting September 2010.

7.2.2. **FTH-GRID - (2009–2011)**

Members: Université de Lisbonne (LASIGE), LIP6 (Regal)

Funding: Egide

Objectives: FTH-Grid, Fault-Tolerant Hierarchical Grid Scheduling, is a cooperation project between the Laboratoire d’Informatique de Paris 6 (LIP6/CNRS, France) and the Large-Scale Informatics Systems Laboratory (LASIGE/FCUL, Portugal).

Its goal is to foster scientific research collaboration between the two research teams. The project aims at rendering Map Reduce on top of Grid tolerant to byzantine failure. Map Reduce is a programming model for large-scale data-parallel applications whose implementation is based on master-slave scheduling of bag-of-tasks. MapReduce breaks a computation into small tasks that run in parallel on different machines, scaling easily to several cluster. The core research activities of the project consist mainly in extending the execution and programming model to make Byzantine fault-tolerant MapReduce applications. The project was extended for another year, after a results assessment by Egide.

7.3. **International Initiatives**

7.3.1. **DEMEDYS - INRIA-CNPq - (2010–2011)**

Members: INRIA Bretagne (ASAP), INRIA Paris Rocquencourt (REGAL), UFBA (Bahia, Brazil), IME (Sao Paulo, Brazil)

Funding: INRIA / CNPq

Objectives: DEMEDYS Project (Dependable Mechanisms for Dynamic Systems) will study fundamental aspects of dynamic distributed systems.

7.3.2. **Dependability of dynamic distributed systems for ad-hoc networks and desktop grid (ONDINA) (2011-2013)**

Members: INRIA Paris Rocquencourt (REGAL), INRIA Rhone-Alpes (GRAAL), UFBA (Bahia, Brazil))

Funding: INRIA

Objectives: Modern distributed systems deployed over ad-hoc networks, such as MANETs (wireless mobile ad-hoc networks), WSNs (wireless sensor networks) or Desktop Grid are inherently dynamic and the issue of designing reliable services which can cope with the high dynamics of these systems is a challenge. This project studies the necessary conditions, models and algorithms able to implement reliable services in these dynamic environments.

7.3.3. **Enabling Collaborative Applications For Desktop Grids (ECADeG) (2011–2013)**

Members: INRIA Paris Rocquencourt (REGAL), USP (Sao Paulo, Brazil))

Funding: INRIA

Objectives: The overall objective of the ECADeG research project is the design and implementation of a desktop grid middleware infrastructure for supporting the development of collaborative applications and its evaluation through a case study of a particular application in the health care domain.
7.3.4. Bi-lateral collaborations

JAIST (Japon). With the group of Prof. Xavier Defago we investigate various aspects of self-organization and fault tolerance in the context of robots networks.

UNLV (USA) With the group of Prof. Ajoy Datta we collaborate in designing self* solutions for the computations of connected covers of query regions in sensor networks.

Technion (Israel). We collaborate with Prof. Roy Friedman on divers aspects of dynamic systems ranging from the computation of connected covers to the design of agreement problems adequate for P2P networks.

Ben Gurion (Israel). We collaborate recently with prof. Shlomi Dolev on the implementation of self-stabilizing atomic memory.

Kent University (SUA). With prof. Mikhail Nesterenko we started recently a collaboration on FTSS solutions for dynamic tasks.

Nagoya Institute of Technology (Japon). With prof. Taisuke Izumi we started this year a collaboration on the probabilistic aspects of robot networks.

COFECUB (Brazil). With the group of Prof. F. Greve, (Univ. Federal of Bahia), we investigate various aspects of failure detection for dynamic environement such as MANET of P2P systems.

CONYCIT (Chili). Since 2007, we start on new collaboration with the group of X. Bonnaire Fabre (Universidad Técnica Federico Santa María - Valparaíso). The main goal is to implement trusted services in P2P environment. Even if it is near impossible to fully trust a node in a P2P system, managing a set of the most trusted nodes in the system can help to implement more trusted and reliable services. Using these nodes, can reduce the probability to have some malicious nodes that will not correctly provide the given service. The project will have the following objectives: 1. To design a distributed membership algorithm for structured Peer to Peer networks in order to build a group of trusted nodes. 2. To design a maintenance algorithm to periodically clean the trusted group so as to avoid nodes whose reputation has decreased under the minimum value. 3. To provide a way for a given node X to find at least one trusted node. 4. To design a prototype of an information system, such as a news dissemination system, that relies on the trusted group.

Collaboration with CITI-UNL, Portugal. Our collaboration with CITI, the Research Center for Informatics and Information Technologies of UNL, the New University of Lisbon (Portugal), is materialised by several joint articles. Furthermore, Marc Shapiro is an advisor to the project “RepComp - Replicated Components for Improved Performance or Reliability in Multicore Systems,” funded by Fundacio para a Ciancia e a Tecnologia (FCT, Portuguese equivalent of ANR). Finally, Marc Shapiro is a Member of the CITI Advisory Board.
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ARC MISSION

Participants: Isabelle Guérin Lassous, Thomas Begin, Paulo Gonçalves.

The project Mobile SubStitutIOn Networks (MISSION) is focused on the performance study, the possibilities and the feasibility to deploy a fleet of mobile wireless routers to help a wired network that has not offered its services anymore. This project deals with the theoretical aspects as well as the practical aspects of such a deployment. From a theoretical point of view, one problem is to minimize the number of used routers while rebuilding the network to replace. The main difficulty lies in the possibility to offer the services provided by the wired network in a transparent way. The controlled mobility allows a redeployment or an adaptation of the built network according to the needs or to the on-going traffic on the network. This controlled mobility should improve the network performance.

8.1.2. GRID5000: ADT Aladdin

Participants: Laurent Lefèvre, Gelas Jean-Patrick, Olivier Glück, Paulo Gonçalves, Matthieu Imbert, Armel Soro, Olivier Mornard, Jean-Christophe Mignot, Diouri Mohammed, Orgerie Anne-Cécile.

ENS Lyon is involved in the GRID’5000 project, which is an experimental Grid platform gathering ten sites geographically distributed in France. ENS Lyon hardware contribution is done for now by two distinct sets of computers. The Grid5000 of Lyon comprises now around 300 processors interconnected with the 10 Gbit per second network. Lyon site is nationally recognized to gather the "networking expertise" with skilled researchers and engineers and dedicated networking equipments (Metroflux, GNET10...). Lyon site also hosts an important part of the Green Grid5000 infrastructure by hosting a set of 1500 wattmeters and exposing energy measurements to the Grid5000 community.

RESO is strongly involved in the choices of Grid5000’s network components and architecture. Laurent Lefèvre is member of the national committee (comité de direction) of GRID’5000, of the Aladdin scientific committee and responsible of the Lyon site.

8.1.3. ANR RESCUE

Participants: Isabelle Guérin Lassous, Thomas Begin, Paulo Gonçalves, Thiago Abreu.

Access and metropolitan networks are much more limited in capacity than core networks. While the latter operate in over-provisioning mode, access and metropolitan networks may experience high overload due to evolution of the traffic or failures. In wired networks, some failures (but not all) are handled by rerouting the traffic through a backup network already in place. In developed countries, backup networks are adopted wherever possible (note that this is generally not the case for the links between end users and their local DSLAM). Such a redundant strategy may not be possible in emerging countries because of cost issues. When dedicated backup networks are not available, some operators use their 3G infrastructure to recover some specific failures; although such an alternative helps avoid full network outage, it is a costly solution. Furthermore, availability of 3G coverage is still mainly concentrated in metropolitan zones. When no backup networks are available, it would be interesting to deploy, for a limited time corresponding to the period of the problem (i.e., failure or traffic overload), a substitution network to help the base network keep providing services to users.
In the RESCUE project (2010-2013), we will investigate both the underlying mechanisms and the deployment of a substitution network composed of a fleet of dirigible wireless mobile routers. Unlike many projects and other scientific works that consider mobility as a drawback, in RESCUE we use the controlled mobility of the substitution network to help the base network reduce contention or to create an alternative network in case of failure. The advantages of an on-the-fly substitution network are manifold: Reusability and cost reduction; Deployability; Adaptability.

The RESCUE project addresses both the theoretical and the practical aspects of the deployment of a substitution network. From a theoretical point of view, we will propose a two-tiered architecture including the base network and the substitution network. This architecture will describe the deployment procedures of the mobile routing devices, the communication stack, the protocols, and the services. The design of this architecture will take into account some constraints such as quality of service and energy consumption (since mobile devices are autonomous), as we want the substitution network to provide more than a best effort service. From a practical point of view, we will provide a proof of concept, the architecture linked to this concept, and the necessary tools (e.g., traffic monitoring, protocols) to validate the concept and mechanisms of on-the-fly substitution networks. At last but not least, we will validate the proposed system both in laboratory testbeds and in a real-usage scenario.

http://rescue.lille.inria.fr/

8.1.4. FUI CompatibleOne Project

**Participants:** Laurent Lefèvre, Jean-Patrick Gelas, Olivier Mornard, Maxime Morel.

The project CompatibleOne (Nov 2010-Nov 2012) funded by the Fonds Unique Interministériel (FUI) is dealing with the building of a Cloud architecture open software stack.

In this project, RESO is focused on the design and provisioning of energy aware and energy efficient components in order to include energy aspects in QoS, SLAs and billing in clouds architectures. RESO is leading the task T3.4 on energy management and will participate in activities on virtual machines design and migration.

CompatibleOne is an open source project with the aim of providing inter-operable middle-ware for the description and federation of heterogeneous clouds comprising resources provisioned by different cloud providers. Services provided by INRIA RESO participation (module COEES) should allow to act on the system’s core by offering a scenario for the broker using energy constraints. These constraints should allow virtual machines placement and displacement using energy profile. Collected data must be available for CO and other systems for future researches. INRIA RESO took part in the analysis of the specification of the system. Mainly, we are in charge of the energy efficiency module. We also had participation in several modules like COMONS (monitoring module), ACCORDS (brokering module), EZVM (virtualization module) and CONETS (networking module). To make energy measurement, we used hardware probes and we studied software probes too. We evaluated several probes providers like Eaton and Schleifenbauer which provide smart PDU (Power Distribution Unit). We also evaluated IPMI board provided by DELL, our computers manufacturer, and OmegaWatt, a small company which provides custom hardware for energy measurement. To allow the exploitation of these probes, we made a first version of a software library and file format for data and monitoring daemon. To allow the use of this system outside of CompatibleOne, we developed a complete monitoring system, which is now in use in IN2P3 data center. To make our tests and developments, we specified, bought, installed and deployed our cluster of 12 nodes. Finally, we participated in international manifestations like SuperComputing 2011 (Poster and demonstration on INRIA booth), Cloud and Green Computing 2011 [46].

8.1.5. FSN Magellan Project

**Participants:** Laurent Lefèvre, Jean-Patrick Gelas.

The project Magellan has been accepted in December 2011. The official beginning will be mid-february 2012.

8.1.6. ANR PETAFLOW

**Participants:** Paulo Gonçalves, Matthieu Imbert, Anne-Cécile Orgerie, Ashley Chonka.
This ANR (Appel Blanc International) started in October 2009 and will end in September 2012. It is a collaborative project between the GIPSA Lab (Grenoble), MOAIS (INRIA Grenoble), RESO (INRIA Grenoble), the University of Osaka (the Cybermedia Center and the Department of Information Networking) and the University of Kyoto (Visualization Laboratory).

We aim at proposing network solutions to guarantee the Quality of Service (in terms of reliability level and of transfer delay properties) of a high speed, long-distance connection used in an interactive, high performance computing application. Another specificity of this application is the peta-scale volume of the treated data corresponding to the upper airway flow modeling.

http://petaflow.gforge.inria.fr/

8.1.7. ANR DMASC

Participant: Paulo Gonçalves.

Started in October 2008, this ANR project, leaded by J. Barral (Univ. Paris 13), is a partnership between INRIA (Sisyphé and Reso), university of Paris 12 and Paris 13 and Paris Sud (équipe d’accueil EA 4046 Service de Réanimation Médicale CHU de Bicêtre).

Its main objective is to develop advanced multifractal analysis tools, from mathematically ground results to efficient estimators. We apply these methods to the analysis, to the modeling and to the classification (for non invasive diagnoses) of cardio-vascular systems.

http://www-rocq.inria.fr/~barral/DMASC.html

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. GEYSERS

Title: Generalised Architecture for dynamic infrastructure services
Type: COOPERATION (ICT)
Defi: The Network of the Future
Instrument: Integrated Project (IP)
Duration: January 2010 - December 2012
Coordinator: Interoute (Italy)

Others partners: Interoute (Italy), martel Martel GmbH (Switzerland), ADVA AG Optical Networking (Germany), SAP AG (Germany), Alcatel-Lucent Italia S.p.A. (Italy), Telefónica I+D (Spain), Telekomunikacja Polska S.A. (Poland), Instytut Chemii Bioorganicznej PAN, Poznan Supercomputing and Networking Centre (Poland), Nextworks s.r.l (Italy), Fundació i2CAT, Internet i Innovació Digital a Catalunya (Spain), Universiteit van Amsterdam (The Netherlands), University of Essex (UK), Research and Education Society in Information Technologies (Greece), Technical University of Braunschweig (Germany), Interdisciplinary Institute for BroadBand Technology VZW (Belgium), Indian Institute of Technology (India), LYaTiss (France), ADVA Optica Networking Sp.zo.o. (Poland)

Abstract: GEYSERS’s vision is to qualify optical infrastructure providers and network operators with a new architecture, to enhance their traditional business operations. Optical network infrastructure providers will compose logical infrastructures and rent them out to network operators; network operators will run cost-efficient, dynamic and mission-specific networks by means of integrated control and management techniques. GEYSERS’s concept is that high-end IT resources at users’ premises are fully integrated with the network services procedures, both at the infrastructure-planning and connection-provisioning phases. Following this vision, GEYSERS will specify and implement a novel optical-network architecture able to support ‘Optical Network + Any-IT’ resource provisioning seamlessly and efficiently. Energy-consumption metrics for the end-to-end service routing are part of this efficiency. GEYSERS proposes to:
• Specify and develop mechanisms that allow infrastructure providers to partition their resources (optical network and/or IT), compose specific logical infrastructures and offer them as a service to network operators. This will be done overcoming the current limitations of networks/domain segmentation, and will support dynamic and on-demand changes in the logical infrastructures.

• Specify and develop a Network Control Plane for the optical infrastructure, by extending standard solutions (ASON/GMPLS and PCE), able to couple optical network connectivity and IT services automatically and efficiently, and provide them in 1 step, dynamically and on-demand, including infrastructure re-planning mechanisms.

These achievements will enable infrastructure providers, network operators and application providers to participate in new business scenarios where complex services with complex attributes and strict bandwidth requirements can be offered economically and efficiently to users and applications. GEYSERS’s outcomes will be validated in an EU-wide optical network test-bed.

8.2.1.2. SAIL

Title: Scalable and Adaptive Internet Solutions
Type: COOPERATION (ICT)
Defi: The Network of the Future
Instrument: Integrated Project (IP)
Duration: August 2010 - January 2013
Coordinator: Ericsson (Sweden)

Others partners: Ericsson AB (Sweden), Alcatel-Lucent Deutschland (Germany), Nokia Siemens Networks Oy (Finland), NEC Europe LTD (United Kingdom), France Telecom SA (France), Telefónica Investigación y Desarrollo (Spain), Telecom Italia (Italy), Portugal Telecom Inovação (Portugal), Swedish institute of Computer science (Sweden), Instituto Superior Técnico de Lisboa (Portugal), Universitàet Paderborn (Germany), Aalto-Korkeakoulusäätiö (Finland), Kungliga Tekniska högskolan (Sweden), Fraunhofer Gesellschaft zur Förderung der angewandten Forschung (Germany), Universitaet Bremen (Germany), Hewlett-Packard Limited (United Kingdom), Fundación Tecnalia Research and Innovation (Spain), Institut Telecom (France), Technion – Israel Institute of Technology (Israel), DOCOMO Communication Laboratories Europe (Germany), The Provost Fellows & Scholars of the College of the Holy and undivided Trinity of Queen Elizabeth (Ireland), National ICT Australia Limited (Australia), Universidad de Cantabria (Spain), Lyatiss (France)

See also: https://twiki.verkstad.net/bin/view/Main/WebHome

Abstract: SAIL’s objective is the research and development of novel networking technologies using proof-of-concept prototypes to lead the way from current networks to the Network of the Future. SAIL leverages state of the art architectures and technologies, extends them as needed, and integrates them using experimentally-driven research, producing interoperable prototypes to demonstrate utility for a set of concrete use-cases. SAIL reduces costs for setting up, running, and combining networks, applications and services, increasing the efficiency of deployed resources (e.g., personnel, equipment and energy). SAIL improves application support via an information-centric paradigm, replacing the old host-centric one, and develops concrete mechanisms and protocols to realize the benefits of a Network of Information (NetInf). SAIL enables the co-existence of legacy and new networks via virtualization of resources and self-management, fully integrating networking with cloud computing to produce Cloud Networking (CloNe). SAIL embraces heterogeneous media from fibre backbones to wireless access networks, developing new signaling and control interfaces, able to control multiple technologies across multiple aggregation stages, implementing Open Connectivity Services (OConS). SAIL also specifically addresses cross-cutting themes and non-technical issues, such as socio-economics, inclusion, broad dissemination, standardization and network migration, driving new markets, business roles and models, and increasing opportunities for both competition
and cooperation. SAIL gathers a strong industry-led consortium of leading operators, vendors, SME, universities and research centers, with a valuable experience acquired in previous FP7 projects, notably 4WARD. The impact will be a consensus among major European operators and vendors on a well-defined path to the Network of the Future together with the technologies required to follow that path.

8.2.1.3. PrimeEnergyIT

Title: SPEC on “Security and Privacy Concerns in Energy Efficient Computing”
Type: COOPERATION (ICT)
Defi: Future Internet Experimental Facility and Experimentally-driven Research
Instrument: Intelligent Energy in Europe
Duration: 2010-2012
Coordinator: Electricity of Austria
Others partners: Berlin Energy Agency, Berlin Institute of Technology, BIO Intelligence Service, Politecnico di Milano, GAIA, ICLEI, University of Coimbra, Seven

Abstract:

The fast development of IT services and IT performance in many areas of the public and private service sector (e.g. administration, health services, entertainment etc.) has led to a rapid increase of energy consumption and energy costs for central IT equipment. EU and US studies (IEEE E-Server project 2007, EPA 2007) have shown a strong increase of energy consumption of central IT-hardware and infrastructure during the last years and a growing trend is expected for the future. For EU-27 the energy consumption of central IT hardware and infrastructure (incl. servers, storage, network equipment, cooling) was calculated to 40TWh/a which is equal to 1.5% of the EU electricity consumption. If business-as-usual is continued in the next years a doubling of energy consumption to 80 TWh/a is expected to occur by 2012 already. A broad implementation of energy efficient technology in the EU however would allow a reduction of energy demand of about 60% compared to the business as usual scenario. Energy efficient technology is available but needs to be broadly implemented in the demand side market. To exploit the enormous saving potentials concerted action is needed across the EU member states. Measures to support energy efficient market development for central IT equipment have been started only recently in 2007. Thus compared to many other areas of technology (lighting, heating, client side IT etc.) activities to support sustainable solutions are quite new and more concerted action is needed to reach a good market impact. The major first initiatives at EU-level were The Green Grid, the Energy Star for servers, the Code of Conduct and the IEEE E-Server project. These programmes started to develop guidelines, tools and criteria to support energy efficiency in data centres. However so far only part of the relevant products and technologies could be covered and energy efficiency criteria as well as market supporting instruments are still at an early stage of development and implementation. The proposed project is designed to further enforce energy efficient market development for central IT equipment based on the previous initiatives and with a focus on so far largely uncovered IT hardware including storage and network equipment as well as new power management technologies. The longer term objectives to be supported by the project are to avoid an annual energy consumption of 70TWh in the EU by 2015 compared to business as usual, to support the development of internationally accepted energy efficiency criteria and standards for central IT equipment and to implement energy efficiency as a key target for the major supply and demand side target groups. These goals shall be supported by the further development of energy efficiency criteria to be considered by the demand and supply side market, by the evaluation and demonstration of most energy efficient technology in best practise and by the development and implementation of education, certification and procurement concepts as major instruments to drive the market. The PrimeEnergyIT project deals with:
The development and implementation of hardware and service based energy efficiency criteria as major tools to support IT and infrastructure managers in the selection and management of IT hardware and cooling equipment.

- The demonstration and evaluation of energy efficient IT solutions in best practise
- Education and training of IT managers and experts to support energy efficient procurement and management
- Implementation of energy efficiency criteria for central IT equipment and cooling in public procurement

INRIA RESO has been mainly involved in energy efficiency criteria in the context of storage for small and medium datacenters.

8.2.1.4. EuroNF JRA.S.1.44 project SPEC

Title: SPEC on “Security and Privacy Concerns in Energy Efficient Computing”
Type: JRA
Defi: Future Internet Experimental Facility and Experimentally-driven Research
Instrument: EuroNef Project
Duration: 2011
Coordinator: University of Passau (Germany)
Others partners: University of Vienna, CERTH (Greece)
Abstract: To design highly energy efficient systems is one of the most important design goals which are under investigation currently. The underlying motifs to design such systems are economical as well as environmental in nature. However, it has been identified that while focusing solely on energy efficiency mechanisms, the other design parameters must also be considered to achieve a well balanced system. Security and privacy aspects are among those very important parameters. This SJRP focuses on the security and privacy aspects involved in the application of modern energy efficiency mechanisms. We focus on two of the key technologies including virtualization for energy efficiency and smart metering. In first part of the project, we investigate the security issues within virtualized environments for energy efficiency while the second part focus on the end user privacy concerns when monitoring physical resources in clouds.

8.2.1.5. COST Action IC804

Title: IC804 COST ACtion on “Energy efficiency for large scale distributed systems”
Type: European COST Action
Duration: 2009-2013
Coordinator: University of Toulouse
Others partners: 20 countries
Abstract: The main objective of the Action is to foster original research initiatives addressing energy awareness/saving and to increase the overall impact of European research in the field of energy efficiency in distributed systems. The goal of the Action is to give coherence to the European research agenda in the field, by promoting coordination and encouraging discussions among the individual research groups, sharing of operational know-how (lessons-learned, problems found during practical energy measurements and estimates, ideas for real-world exploitation of energy aware techniques, etc.). The Action objectives can be summarized on scientific and societal points of view: sharing and merging existing practices will lead the Action to propose and disseminate innovative approaches, techniques and algorithms for saving energy while enforcing given Quality of Service (QoS) requirements. Laurent Lefèvre is Management Committee member and French representative in this COST action.
8.3. International Initiatives

8.3.1. Visits of International Scientists

In the context of EuroNef project Spec Action, INRIA RESO has hosted Thomas Treutner from University of Vienna (Austria) during 2 weeks in July 2011. With RESO researchers, he has explored the topic of privacy in clouds when energy monitoring is performed. This collaboration has resulted in an international publication [26].
7. Partnerships and Cooperations

7.1. Regional Initiatives

We have signed a convention with team DIA led by Noury Bouraqadi of Ecole des Mines de Douai. In such context we co-supervised two PhD students (Mariano Martinez-Peck and Nick Papoylias). The team is also an important contributor and supporting organization of the Pharo project.

7.2. National Initiatives

7.2.1. Cutter ANR Project

Stéphane Ducasse [correspondant], Nicolas Anquetil.

Participants are RMoD and the D’Oc (M. Huchard)–APR(J.C. Koenig) groups at Lirmm. The aim of Cutter is to develop, combine, and evaluate new techniques for analyzing and modularizing code. The innovation of Cutter is to: (1) combine different package decomposition techniques (graph decomposition, program visualization...); (2) support different levels of abstractions (system, packages, classes); and (3) be directed by the quality of the resulting remodularization and take into account expert input.

7.2.2. Resilience FUI Project

Stéphane Ducasse [correspondant], Marcus Denker. Participants: Nexedi, Morphom Alcatel-Lucent Bell Labs, Astrium Geo Information, Wallix, XWiki, Alixen, Alterway, Institut Télécom, Université Paris 13, CEA LIST, Inria. Started in September 2011-September 2014.

RESILIENCE’s goal is to protect private data on the cloud, to reduce spying and data loss in case of natural problems. RESILIENCE propose to develop a decentralized cloud architecture: SafeOS. Safe OS is based on replication of servers. In addition a safe solution for document should be developed. Sandboxing for Javascript applications should be explored.

7.3. European Initiatives

Participants: Stéphane Ducasse [correspondant], Veronica Uquillas Gomez, Marcus Denker.

7.3.1. IAP MoVES

Participant: Stéphane Ducasse [correspondant].

The Belgium IAP (Interuniversity Attraction Poles) MoVES (Fundamental Issues in Software Engineering: Modeling, Verification and Evolution of Software) is a project whose partners are the Belgium universities (VUB, KUL, UA, UCB, ULB, FUNDP, ULg, UMH) and three European institutes (Inria, IC and TUD) respectively from France, Great Britain and Netherlands. This consortium combines the leading Belgian research teams and their neighbors in software engineering, with recognized scientific excellence in MDE, software evolution, formal modeling and verification, and AOSD. The project focusses on the development, integration and extension of state-of-the-art languages, formalisms and techniques for modeling and verifying dependable software systems and supporting the evolution of Software-intensive systems. The project has started in January 2007 and is scheduled for a 60-months period. Read more at http://moves.vub.ac.be .

7.3.2. Réseau ERCIM Software Evolution

We are involved in the ERCIM Software Evolution working group since its inception. We participated at his creation when we were at the University of Bern.
7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. PLOMO

- Title: Customizable Tools and Infrastructure for Software Development and Maintenance
- Inria principal investigator: Stéphane Ducasse
- International Partner:
  - Institution: Universidad de Chile (Chile)
  - Laboratory: PLEIAD
- Duration: 2011 - 2013
- See also: http://pleiad.dcc.uchile.cl/research/plomo

Project Description

Software maintenance is the process of maintaining a software system by removing bugs, fixing performance issues and adapting it to keep it useful and competitive in an ever-changing environment [44]. Performing effective software maintenance and development is best achieved with effective tool support, provided by a variety of tools, each one presenting a specific kind of information supporting the task at hand [47]. The goal of PLOMO is to develop new meta tools to improve and bring synergy in the existing infrastructure of Pharo (for software development) and the Moose software analysis platform (for software maintenance).

PLOMO will (1) enhance the Opal open compiler infrastructure to support plugin definition, (2) offer an infrastructure for change and event tracking as well as model to compose and manipulate them, (3) work on a layered library of algorithms for the Mondrian visualization engine of Moose, (4) work on new ways of profiling applications. All the efforts will be performed on Pharo http://www.pharo-project.org and Moose http://www.moosetechnology.org/, two platforms heavily used by the RMoD and PLEIAD team.

The outcomes of PLOMO will include new research advances in the field of (i) bytecode generation for dynamic language; (ii) change and event tracking; (iii) software visualization engine; (iv) agile profiling framework. These four topics are recurrently considered by the most prestigious and competitive conferences (e.g., ECOOP, OOPSLA, FSE, ESEC, ICSE, TOOLS) and journals (e.g., TSE, TOPLAS, ASE), to which the participants of the PLOMO project are used to publish.

A strong focus on publishing our results in relevant scientific forum will remain a top priority. The artifacts produced by PLOMO will strongly reinforce the Pharo programming language and the Moose software analysis platform. The development and progress of Pharo is structured by RMoD, which has successfully created a strong and dynamic community. Moose is being used to realize consulting activities and it is used as a research platform in about 10 Universities, worldwide. We expect PLOMO to have a strong impact in both the software products and the communities structured around them.

Publications

1. S. Ducasse, M. Oriol, A. Bergel, Challenges to support automated random testing for dynamically typed languages [17]
3. Romain Robbes, Johan Fabry, Marcus Denker, DIE: A Domain Specific Aspect Language for IDE Events, in submission
Research Visits

- Vanessa Pena and A. Bergel, Aug 15 until Aug 20. From Aug 20 until Aug 28 they attended ESUG 2011, a conference co-organized by RMoD.
- Romain Robbes from July 18 until July 24.
- Esteban Allende from July 19 until October 2. Esteban’s stays is founded by the French Embassy in Chile. He received a grant of 3180 euros.
- Marcus Denker visited Chile Nov 7th-28th.

7.4.2. Visits of International Scientists

Dr. Andy Kellens from the VUB is visiting us during 3 months.

In the context of the PLOMO associated Team with the University of Chile we got three visitors over a period of one week (V. Pena, A. Bergel, R. Robbes). Esteban Allende, a PhD Student from Pleiad University of Chile, visited from July-Sept 2011.

7.4.2.1. Internships

RMoD hosted students for internships:

- Guido Chari, University of Buenos Aires, Argentina, Sept.-Dec. 2011
- Cesar Couto, Federal University of Minas Gerais, Brazil, Dec. 2011-Fev. 2012 as part of the Pequi project (see 7.4.3.2)

7.4.3. Participation In International Programs

7.4.3.1. STICAmssud

This project focuses on software remodularization. Aspects, Traits and Classboxes are proved software mechanisms to provide modules in software applications. However, reengineering-based methodologies using these mechanisms have not yet been explored so far. This project intends to show how visualization and clustering techniques (such as Formal Concept Analysis) are useful to cope with the comprehension and transformation of module-based applications to applications which could use these mechanisms (i.e. aspects, traits, classboxes). The research results will be applied in a common reengineering platform MOOSE to show the applicability of the concepts.

CoReA spans three research institutions: Inria (the Lille Nord Europe research center, France), University of Chile (Santiago, Chile), LIFIA - Universidad Nacional de La Plata (La Plata, Argentina). The three national project leaders are Dr. Gabriela Arévalo (LIFIA - UNLP), Dr. Alexandre Bergel (Inria), Prof. Dr. Johan Fabry (University of Chile). The international coordinator is Dr. Alexandre Bergel. Participants are: Prof. Dr. Eric Tanter (University of Chile), and Dr. Stéphane Ducasse (senior scientist at Inria).

Marcus Denker visited Argentina November 3rd to November 5th, 2011.

7.4.3.2. Project Pequi – Inria/CNPq Brésil

The Pequi project is a collaboration between Professor Marco T. Valente’s team at the Federal University of Minas Gerais in Brazil and the RMoD team. It focuses in producing Metrics, Techniques, and Tools for Software Remodularization.

It is recognized that software systems must be continuously maintained and evolved to remain useful. However, ongoing maintenance over the years contributes to degrade the quality of a system. Thus reengineering activities, including remodularization activities, are necessary to restore or enhance the maintainability of the systems. To help in the remodularization of software systems, the project will be structured in two main research lines in which both teams have experience and participation: (i) Evaluation and Characterization of Metrics for Software Remodularization; and (ii) Tools and Techniques for Removal of Architectural Violations.

The project started in July 2011 with a visit of Dr. Nicolas Anquetil to the brazilian team. The project will last 24 months.
8. Partnerships and Cooperations

8.1. National Initiatives

COOP We participate to a research proposal to the ANR Cosinus program called “COOP” which was granted a three-year funding (dec. 2009 – dec. 2012). It aims at establishing generic cooperation mechanisms between resource management, runtime systems, and application programming frameworks to simplify programming models, and improve performance through adaptation to the resources. It involves academic partners and EDF R&D. (http://coop.gforge.inria.fr/)

FP3C We participate to the joint ANR-JST project FP3C (Framework and Programming for Post Petascale Computing). The goal of this project is to contribute to establish software technologies, languages and programming models to explore extreme performance computing beyond petascale computing, on the road to exascale computing.

ProHMPT Participants: Cédric Augonnet, Olivier Aumage, Denis Barthou, Andres Charif-Rubial, Jérôme Clet-Ortega, Nathalie Furmento, Raymond Namyst, Ludovic Stordeur, François Tessier, Samuel Thibault, Pierre-André Wacrenier.

We lead a research proposal to the ANR Cosinus program called “ProHMPT” which was granted a three-year funding (jan. 2009 – jun. 2012). It aims at focusing the joint research work of several teams about compilers, runtimes and libraries on programming heterogeneous platforms such as GPU and accelerators. It involves academic partners, companies (Bull, CAPS entreprise) and CEA teams. Olivier AUMAGE is the head of the ANR ProHMPT project. (http://runtime.bordeaux.inria.fr/prohmpt/)

Hemera The runtime team is member of the large wigspan project Hémera started in 2010, that aims at demonstrating ambitious up-scaling techniques for large scale distributed computing by carrying out several dimensioning experiments on the Grid’5000 infrastructure, at animating the scientific community around Grid’5000 and at enlarging the Grid’5000 community by helping newcomers to make use of Grid’5000. It is not restricted to INRIA teams.

MEDIAGPU We participate to a research proposal to the ANR CONTINT program called “MEDIAGPU” which was granted a 30-month funding (jan. 2010 - jun. 2012). It will develop a software architecture and will review and adapt a number of classical multimedia algorithms, considering the latest advances offered by the new hardware architectures, such as combinations of CPUs and GPUs (http://picoforge.int-evry.fr/projects/mediagpu/).

8.2. European Initiatives

8.2.1. FP7 Project

8.2.1.1. PEPPHER

Title: Performance Portability and Programmability for Heterogeneous Many-core Architectures
Type: COOPERATION (ICT)
Defi: Computing Systems
Instrument: Specific Targeted Research Project (STREP)
Duration: October 2010 - December 2012
Coordinator: Universität Wien (Austria)
Abstract: PEPPHER will provide a unified framework for programming architecturally diverse, heterogeneous many-core processors to ensure performance portability. PEPPHER will advance state-of-the-art in its five technical work areas:

1. Methods and tools for component based software
2. Portable compilation techniques
3. Data structures and adaptive, autotuned algorithms
4. Efficient, flexible run-time systems
5. Hardware support for autotuning, synchronization and scheduling

8.2.2. Collaborations in European Programs, except FP7

Program: COST
Project acronym: ComplexHPC
Project title: Open Network for High-Performance Computing on Complex Environments
Duration: may 2009 – may 2013
Coordinator: Emmanuel Jeannot
Other partners: 24 European Countries, 2 non-European counties.

Abstract: The goal of the Action is to establish a European research network focused on high performance heterogeneous computing in order to address the whole range of challenges posed by these new platforms including models, algorithms, programming tools and applications.

8.3. International Initiatives

8.3.1. INRIA Associate Teams

The goal of Matrices Over Runtime Systems at Exascale (MORSE) project is to design dense and sparse linear algebra methods that achieve the fastest possible time to an accurate solution on large-scale multicore systems with GPU accelerators, using all the processing power that future high end systems can make available. To develop software that will perform well on petascale and exascale systems with thousands of nodes and millions of cores, several daunting challenges have to be overcome, both by the numerical linear algebra and the runtime system communities. By designing a research framework for describing linear algebra algorithms at a high level of abstraction, the MORSE team will enable the strong collaboration between research groups in linear algebra and runtime systems needed to develop methods and libraries that fully benefit from the potential of future large-scale machines. Our project will take a pioneering step in the effort to bridge the immense software gap that has opened up in front of the High-Performance Computing (HPC) community.

8.3.2. INRIA International Partners

- The Runtime project is the representative of Inria within the MPI Forum which designs and maintains the Message Passing Interface Standard (http://www.mpi-forum.org).
- We established a collaboration with the OPEN MPI project in the context of development of the HWLOC software (see Section 5.2). This collaboration was also informally extended to the development of high-performance intra-node communication with OPEN MPI over our KNEM driver (see Section 5.3).
• Runtime is a member of the CCI project together with the Oak Ridge National Laboratory and several other American academic and industrial partners (http://www.cci-forum.org). See Section 5.1.
• The Runtime project is part of the joint laboratory that was setup between INRIA and University of Illinois Urbana-Champaign (UIUC) about Petascale Computing (http://jointlab.ncsa.illinois.edu/).

8.3.3. Visits of International Scientists

• Jan PERHAC from Trondheim University visited the runtime team as an ERCIM Fellow from March 7 to March 11. We worked on the Thor runtime system.
• Keisuke FUKUDA from Tokyo Tech visited from December 12th to Friday 16th, for the FP3C project, to port an FMM application on top of StarPU.
• Tetsuya ODAJIMA from University of Tsukuba, Japan visited the Runtime Team from September 2th to September 16th, for the FP3C Project, to integrate the XcalableMP language environment with StarPU.
• Satoshi OHSHIMA from Tokyo University visited from April 4th to April 15th, for the FP3C project, to work on FEM methods.
7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. ARAVIS (ANR-Minalogic)

Participants: Vivien Quéma, Renaud Lachaize, Fabien Gaud, Sylvain Genevès, Fabien Mottet, Baptiste Lepers.

The ARAVIS project aims at addressing the challenges raised, both at the hardware and software levels, by the production of highly integrated multiprocessor systems on chip (MPSoCs) designed for demanding applications such as video encoding/decoding and software-defined radio communications. Due to the complexity of the manufacturing process, the latest generations of chips exhibit peculiar features that must be taken into account: (i) massively parallel processing units, (ii) irregular behavior and aging of the processing units due to unavoidable defects of the manufacturing process. The ARAVIS project strives to provide a hardware and software platform suited to the adaptation requirements raised by the needs of such emerging hardware technologies and applications. The proposed approach encompasses three contributions: (i) a symmetric hardware architecture based on an asynchronous interconnect with integrated voltage/frequency scaling, (ii) a set of regulation algorithms based on control theory to optimize quality of service and energy consumption, (iii) a component-based runtime environment and related software tools to ease the dynamic management of applications and execution resources.

The project partners are STMicroelectronics, CEA-LETI, TIMA and INRIA (Necs and Sardes project teams). The project runs from October 2007 to September 2011.

7.1.2. MIND (ANR-Minalogic)

Participants: Eric Rutten, Jean-Bernard Stefani, Tayeb Bouhadiba, Cinzia di Giusto.

The MIND project aims to develop an industrial technology for component-based construction of embedded systems, based on the Fractal component model.

This includes the development of programming languages (extended C, ADL, IDL), a chain for compiling software architecture descriptions and generating code, and a graphical IDE integrated to Eclipse. In addition, the project aims to study extensions and refinements to the Fractal model suitable for dealing with non-functional aspects such as real-time and priority constraints, the model-based control of dynamic reconfiguration of components, and its integration with the BIP component model developed at the Verimag laboratory.

The project partners include STMicroelectronics, CEA, INRIA (Adam and Sardes project teams), Schneider. The project runs from October 2008 to May 2011.

7.2. National Initiatives

7.2.1. ASR Network

The Sardes team is a member of the CNRS research network GDR 725 ASR “Architecture, Système et Réseau”. See http://asr.univ-perp.fr/.

7.2.2. Automatique pour l’informatique autonome (CNRS PEPS)

Participant: Eric Rutten.

This project is lead by Eric Rutten and funded by CNRS in the programme Projet Exploratoire-Premier(s) Soutien(s) PEPS Rupture de l’INS2I 2011. It concerns Control Techniques for Autonomic Computing, and intends to group researchers of different backgrounds (Architectures and FPGA, distributed systems and adaptative software, programming languages for reconfiguration, and control theory) to gather experiences and points of view on this multi-disciplinary topic.
7.2.3. **Cogip (CNRS PEPS)**
**Participant:** Damien Pous.

This project is lead by Filippo Bonchi (LIP, Lyon), and it includes two researchers from Paris: Samuel Mimram (CEA), and Paul-André Melliès (PPS). This project focuses on semantics of concurrent programming languages, by working at the interface between coalgebraic methods and game semantics.

http://perso.ens-lyon.fr/daniel.hirschkoff/cogip/

7.2.4. **SocEDA (ANR Arpege project)**
**Participants:** Vivien Quéma, Baptiste Lepers.

The goal of SocEDA is to develop and validate an elastic and reliable federated SOA architecture for dynamic and complex event-driven interaction in large highly distributed and heterogeneous service systems. Such architecture will enable exchange of contextual information between heterogeneous services, providing the possibilities to optimize/personalize the execution of them, according to social network information.

The main outcome of the SocEDA project will be a platform for event-driven interaction between services, that scales at the Internet level based on the proposed architecture and that addresses Quality of Service (QoS) requirements.

The project partners are INRIA (ADAM in Lilles), EBM WebSourcing (FR), ActiveEon (FR), ARMINES (FR), France Telecom R&D (FR), CNRS (I3S and LIG), INSA Lyon, Thales Communications.

The project runs from October 2010 to September 2013.

7.2.5. **PiCoq (ANR project)**
**Participants:** Damien Pous, Alan Schmitt, Jean-Bernard Stefani, Thomas Braibant.

The goal of the PiCoq project is to develop an environment for the formal verification of properties of distributed, component-based programs. The project’s approach approach lies at the interface between two research areas: concurrency theory and proof assistants. Achieving this goal relies on three scientific advances, which the project intends to address:

- Finding mathematical frameworks that ease modular reasoning about concurrent and distributed systems: due to their large size and complex interactions, distributed systems cannot be analysed in a global way. They have to be decomposed into modular components, whose individual behaviour can be understood.

- Improving existing proof techniques for distributed/modular systems: while behavioural theories of first-order concurrent languages are well understood, this is not the case for higher-order ones. We also need to generalise well-known modular techniques that have been developed for first-order languages to facilitate formalisation in a proof assistant, where source code redundancies should be avoided.

- Defining core calculi that both reflect concrete practice in distributed component programming and enjoy nice properties w.r.t. behavioural equivalences.

The project partners include INRIA (Sardes), LIP (Plume team), and Université de Savoie. the project runs from November 2010 to October 2014.

The ANR PiCoq is in the programme ANR 2010 BLAN 0305 01: [http://sardes.inrialpes.fr/collaborations/PiCoq/](http://sardes.inrialpes.fr/collaborations/PiCoq/)

7.2.6. **Project MyCloud (ANR project)**
**Participants:** Amit Sangroya, Sara Bouchenak, Dàmian Serrano.
The objective of the MyCloud project is to define and implement a novel cloud model: SLAaaS (SLAaware Service). The SLAaaS model enriches the general paradigm of Cloud Computing, and enables systematic and transparent integration of service levels and SLA to the cloud. SLAaaS is orthogonal to IaaS, PaaS and SaaS clouds and may apply to any of them. The MyCloud project takes into account both the cloud provider and cloud customer points of view. From cloud provider’s point of view, MyCloud proposes autonomic SLA management to handle performance, availability, energy and cost issues in the cloud. An innovative approach combines control theory techniques with distributed algorithms and language support in order to build autonomic elastic clouds. Novel models, control laws, distributed algorithms and languages will be proposed for automated provisioning, configuration and deployment of cloud services to meet SLA requirements, while tackling scalability and dynamics issues. On the other hand from cloud customer’s point of view, the MyCloud project provides SLA governance. It allows cloud customers to be part of the loop and to be automatically notified about the state of the cloud, such as SLA violation and cloud energy consumption. The former provides more transparency about SLA guaranties, and the latter aims to raise customers’ awareness about cloud’s energy footprint.

The project partners are INRIA (Sardes is the project coordinator), Grenoble; LIP6, Paris; EMN, Nantes; We Are Cloud, Montpellier; Elastic Grid LLC, USA.

The project runs from November 2010 to October 2013.

7.2.7. Famous (ANR project)

Participants: Eric Rutten, Xin An.

The FAMOUS project (FAst Modeling and Design FIow for Dynamically ReconfigUrable Systems) intends to make reconfigurable hardware systems design easier and faster, by introducing a complete methodology that takes the reconfigurability of the hardware as an essential design concept and proposes the necessary mechanisms to fully exploit those capabilities at runtime. The tool under development in this project is expected to be used by both industrial designers and academic researchers, especially for modern application system specific design such as smart cameras, image and video processing, etc.

The project partners are INRIA (Sardes in Grenoble and DaRT in Lille), Université de Bretagne Sud, Université de Bourgogne, Sodius.

The project runs from December 2009 to November 2013.

7.3. European Initiatives

7.3.1. FP7 ICT Project

7.3.1.1. PLAY

Title: Pushing dynamic and ubiquitous interaction between services Leveraged in the Future Internet by ApplYing complex event processing

Type: COOPERATION (ICT)

Defi: Internet of Services, Software & Virtualisation

Instrument: Specific Targeted Research Project (STREP)

Duration: October 2010 - September 2013

Coordinator: FZI (Germany)

Others partners: INRIA (Oasis in Sophia), FZI (Germany), ICCS (Greece), EBM WebSourcing (FR), ARMINES (FR), France Telecom R&D (FR), CIM Grupa DOO (RS)

See also: http://www.play-project.eu/
Abstract: The goal of PLAY is to develop and validate an elastic and reliable federated SOA architecture for dynamic and complex, event-driven interaction in large highly distributed and heterogeneous service systems. Such architecture will enable exchange of contextual information between heterogeneous services, providing the possibilities to optimize/personalize the execution of them, resulting in the so called situational-driven adaptivity.

The main outcome will be a FOT (federated open trusted) Platform for event-driven interaction between services, that scales at the Internet level based on the proposed architecture and that addresses Quality of Service (QoS) requirements. The platform consists of:

Federated middleware layer: a peer-to-peer overlay network combined with a publish/subscribe mechanism, that has the task to collect events coming from the heterogeneous and distributed services,

Distributed complex event processor: an elastic, distributed computing cloud based engine for complex processing/combining of events coming from different services in order to detect interesting situations a service should react on

Situational-aware business adapter: a recommender engine for proposing adaptation and changes in running business processes and services in a non-predefined (ad-hoc) way, by ensuring the consistency of the whole instance

The system will be tested in two use cases: crisis management and telecom industry, showing the advantages of such an architecture for Future Internet. Indeed, PLAY aims to revolutionize the Future Internet by making it situational-aware, which leads to the event-aware services that are able to proactively adapt themselves to the changes in the environment.
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR ConcoRDanT ANR-10-BLAN-0208 (2010–2013)

Participants: Pascal Urso [contact], Mehdi Ahmed-Nacer, Claudia Ignat, Gérald Oster.

Partners: REGAL project-team (INRIA Paris - Rocquencourt / LIP6, coordinator), CITI institute (Universidade Nova de Lisboa, Portugal), GDD team (University of Nantes) and SCORE team.

Website: http://concordant.lip6.fr/

Massive computing systems and their applications suffer from a fundamental tension between scalability and data consistency. Avoiding the synchronisation bottleneck requires highly skilled programmers, makes applications complex and brittle, and is error-prone.

The ConcoRDanT project (oct. 2010 – sep. 2013) will investigate a promising new approach that is simple, scales indefinitely, and provably ensures eventual consistency. A Commutative Replicated Data Type (CRDT) is a data type where all concurrent operations commute. If all replicas execute all operations, they converge; no complex concurrency control is required. We have shown in the past that CRDTs can replace existing techniques in a number of tasks where distributed users can update concurrently, such as co-operative editing, wikis, and version control. However CRDTs are not a universal solution and raise their own issues (e.g., growth of meta-data).

The ConcoRDanT project engages in a systematic and principled study of CRDTs, to discover their power and limitations, both theoretical and practical. Its outcome will be a body of knowledge about CRDTs and a library of CRDT designs, and applications using them. We are hopeful that significant distributed applications can be designed using CRDTs, a radical simplification of software, elegantly reconciling scalability and consistency.

8.1.2. ANR STREAMS ANR-10-SEGI-010 (2010–2013)

Participants: Gérald Oster [coordinator], Luc André, Claudia Ignat, Pascal Urso, Hien Thi Thu Truong.

Partners: SCORE team (coordinator), ASAP project-team (University of Rennes 1 / INRIA Rennes - Bretagne Atlantique), CASSIS project-team (INRIA Nancy - Grand Est / Nancy University), REGAL project-team (INRIA Paris - Rocquencourt / LIP6) and GDD team (University of Nantes / LINA).

Website: http://streams.loria.fr/

The STREAMS project (nov. 2010 – oct. 2013) proposes to design peer-to-peer solutions that offer underlying services required by real-time social web applications and that eliminate the disadvantages of centralised architectures. These solutions are meant to replace a central authority-based collaboration with a distributed collaboration that offers support for decentralisation of services.

The STREAMS project aims to advance the state of the art on peer-to-peer networks for social and real-time applications. Scalability is generally considered as an inherent characteristic of peer-to-peer systems. It is traditionally achieved using replication technics. Unfortunately, the current state of the art in peer-to-peer networks does not address replication of continuously updated content due to real-time user changes. Moreover, there exists a tension between sharing data with friends in a social network deployed in an open peer-to-peer network and ensuring privacy. One of the most challenging issues in social applications is how to balance collaboration with access control to shared objects. Interaction is aimed at making shared objects available to all who need them, whereas access control seeks to ensure this availability only to users with proper authorisation. STREAMS project aims at providing theoretical solutions to these challenges as well as practical experimentation.
8.1.3. Wiki 3.0 (2009–2012)

Participants: Claudia Ignat [contact], Luc André, Gérald Oster, Gérôme Canals, Bogdan Flueras.

Partners: XWiki SAS, SCORE team and Mandriva.
Website: http://wiki30.xwikisas.com/

The Wiki 3.0 project (dec. 2009 - juin 2012) is sponsored by the call for projects “Innovative Web” launched by the French Ministry of Economy. The objective of this project is the development of an open-source platform based on XWiki (http://www.xwiki.org) that addresses the three major evolution axes of collaborative Web: real-time collaboration, social interaction integrated into the production (chat, micro-blogging, etc) and on demand scalability (cloud computing). This platform should be competitive with major editors of collaborative Web developed by Google such as Google Wave, IBM and Microsoft.


Participants: Gérôme Canals, Christophe Bouthier.

Website: http://www.projet-coclico.org/

The Coclico project (oct. 2009 – nov. 2011) aims to boost software forges communities by structuring a free and open source ecosystem for which a critical mass of actors exists in France. This reinforcement of communities is a key aspect to leverage issues related to collaborative and distributed software development that business companies are confronted.

In the framework of this project, SCORE Team has been designing and prototyping a demonstrator of the first semantic-based software forge.

8.1.5. ANR Kolflow (2011–2014)

Participant: Gérôme Canals.

Partners: GDD team (University of Nantes / LINA), Loria (Orpailleur and Score Teams), Silex Team (LIRIS, University of Lyon), Edelweiss (INRIA Project).
Website: http://kolflow.univ-nantes.fr/mediawiki/index.php

Kolflow aims at building a social semantic space where humans collaborate with smart agents in order to produce knowledge understandable by humans and machines. Humans are able to understand the actions of smart agents. Smart agents are able to understand actions of humans. Kolflow targets the co-evolution of content and knowledge as the result of interactions of humans and machines.


Participant: François Charoy [contact].

This project is a collaboration between LORIA, the Technological University of Troyes and EDF R&D and is sponsored by the GIS 3SGS. It aims to start a pluridisciplinary investigation on facilitating crisis management decision-making.

8.2. International Initiatives

8.2.1. INRIA International Partners

François Charoy has been invited by NICTA (National ICT Australia Ltd) in the team of Anna Liu during his stay in Australia to contribute to a project involving BPM and the Cloud. This work is ongoing.

8.2.2. Visits of International Scientists

Victor Grishchenko, post-doc, TU Delft visited our group for two days in February 2011.
Ilaria Liccardi, postdoc in In-situ INRIA team in Paris who finished her Phd thesis at University Southampton visited our group for one day in September 2011.

8.2.3. Participation In International Programs

8.2.3.1. GIS Interop Grande Région

Participants: Nacer Boudjlida [responsible], Khalid Benali, François Charoy, Olivier Perrin.

Following the INTEROP Network of Excellence, the INTEROP V-Lab (International Virtual Laboratory on interoperability, http://www.interop-vlab.eu/ ) has been officially created in Brussels on March 2007 as an international non-profit making association. In this context, Nancy played also a leading role in the definition of the V-Lab and in the settlement of the so-called INTEROP Grande Region pole, a partner of the INTEROP V-Lab http://www.interop-grande-region.eu/ . On behalf of UHP Nancy 1, Nacer Boudjlida is the legal representative of this pole in the V-Lab and he is also the head of its management board. The Grande Region pole encompasses University of Namur, University of Paris I La Sorbonne, University Henri Poincaré Nancy 1 and University of Nancy 2 as the founding partners. It is defined as a Scientific (International) Interest Group (Groupement d’Intérêt Scientifique or GIS). Its attachment to the INTEROP V-Lab has been achieved in May 2009. In 2010, three institutions joined the INTEROP Grande Region pole: INSA Lyon, University Lyon III and INSA Strasbourg.

8.2.3.2. Associate Team INRIA VanaWeb

SCORE is involved in the Associate Team INRIA VanaWeb (with UTFSM Valparaíso, Chili) which is interested in autonomous constraint solving concepts and their application to composition problems for Web services. The coordinators of this project are Carlos Castro (UTFSM Valparaíso, Chili) and Christophe Ringeissen (CASSIS).

8.2.3.3. Co-advisory of PhD Thesis

- PhD Thesis of Yongxin Liao (UHP Nancy 1, LORIA and CRAN): started November 2010
- PhD Thesis of Badrina Gasmi with Béjaia University, Algeria: starts January 2011 (Nacer Boudjlida)
- PhD Thesis of Faïza Bouchaib with Béjaia University, Algeria: starts January 2011 (Nacer Boudjlida)
7. Partnerships and Cooperations

7.1. National Actions

7.1.1. ANR VERSO ARESA2 - “Avancées en Réseaux de capteurs Efficaces, Sécurisés et Auto-Adaptatifs” (2009-2012, 160 keuros)
Participants: Fabrice Valois, Marine Minier.

ARESA2 is a national initiative (ANR) started in December 2009 and focusing on IP and Security issues in wireless sensor networks. It follows the first ANR/RNRT - ARESA. Fabrice Valois is the leader of the workpackage about self-organisation and Marine Minier is involved in the workpackage on security. The leader of ARESA2 is Orange Labs and the others partners are: Coronis Systems, VERIMAG, LIG, Télécom Bretagne and INRIA.

7.1.2. ANR - Banet - Body Area Networks and Technologies (2007-2010, 129 keuros)
Participants: Paul Ferrand, Jean-Marie Gorce, Claire Goursaud, Nikolaï Lebedev, Guillaume Villemaud.

Banet is a national initiative (ANR) started in January 2008 and focusing on Body Area Network (BAN) systems. Jean-Marie Gorce is the leader of the workpackage ‘Standard air interface, network and protocol system design’. The budget for Swing is 120 keuros. Providing a framework for Body Area Networks (BAN), defining a reliable communication protocol, optimizing BAN technologies and enhancing energy efficiency of network components are the major stakes of then National Project BANET, led by CEA-Leti. It aims at defining precise frameworks to design optimized and miniaturized wireless communication systems. These body area networks target a wide applications range, such as consumer electronics, medical care and sports.

7.1.3. ANR - ECOSCELLS - Efficient Cooperating Small Cells (2009-2012, 260 keuros)

ECOSCELLS is a national initiative (ANR) which aims at developing algorithms and solutions to ease Small Cells Network (SCN) deployment. Theoretical studies will provide models for understanding the impact of radio channels, and to permit the definition of new algorithms exploiting a full diversity (user, spatial, interferences, etc.) of such networks. The novelty of the project is not to consider the interference as a drawback anymore, but to exploit it in order to offer an optimal resource utilization. The algorithms will be based on most recent developments in distributed algorithms, game theory, reinforcement learning. Architecture and algorithms for the backhauling network will also be proposed.

7.1.4. ANR - Rapide - Design and analysis of stream ciphers for constrained environments (2006-2011, 47 keuros)
Participants: Cédric Lauradoux, Marine Minier.

Rapide is a national initiative (ANR). Marine Minier is responsible of the work package “MACs construction”. Stream ciphers are less popular than their block ciphers counterparts, due to the lack of real standards. However, they become essential as soon as we want to reach important flows for limited costs in software or hardware. The aim of this national project is to study, construct and evaluate new stream ciphers built upon a non-linear transition function and to better evaluate the properties of the filtering function to discard known attacks, especially the algebraic ones.

7.1.5. ANR INS BLOC - “block ciphers dedicated to constrained environments” (2011-2015, 80 keuros)
Participants: Marine Minier, Cédric Lauradoux.
BLOC is a research project partially funded by the French National Research Agency. It has been proposed to INS 2011 call. It aims at studying the design and analysis of block ciphers dedicated to constrained environments.


Participants: Paul Ferrand, Jean-Marie Gorce, Claire Goursaud, Isabelle Augé-Blum.

Cormoran project targets to figure out innovative communication functionalities and radiolocation algorithms that could benefit from inter/intra-WBAN cooperation. More precisely, the idea is to enable accurate nodes/body location, as well as Quality of Service management and communications reliability (from the protocol point of view), while coping with inter-WBAN coexistence, low power constraints and complying with the IEEE 802.15.6 standard. The proposed solutions will be evaluated in realistic applicative scenarios, hence necessitating the development of adapted simulation tools and real-life experiments based on hardware platforms. For this sake, CORMORAN will follow an original approach, mixing theoretical work (e.g. modelling activities, algorithms and cross-layer PHY/MAC/NWK design) with more practical aspects (e.g. channel and antennas measurement campaigns, algorithms interfacing with real platforms, demonstrations).

7.1.7. FUI ECONHOME - “Energy efficient home networking” (2010-2014, 330 keuros)

Participants: Nikolaï Lebedev, Florin Hutu, Jean-Marie Gorce, Guillaume Villemaud.

The project aims at reducing the energy consumption of the home (multimedia) data networks, while maintaining the quality requirements for heterogeneous services and flows, and preserving, or even enhancing the overall system performance. The equipments under concern are residential gateways, set-top-boxes (STB), PLC modules, Wifi extenders, NAS. The user equipment, such as smartphones, tablets or PCs are not concerned. The approach relies on combining both individual equipments IC and system level protocols that have to be eco-designed.


Participants: Virgile garcia, Sandesh Uppoor, Nikolaï Lebedev, Jean-Marie Gorce, Hervé Rivano, Fabrice Vailois, Marco Fiore.

This action is a part of the common lab of Inria and Alcatel Lucent Bell Labs. This action groups several team of Inria with Alcatel teams and adresses different aspects of Self Networking: distributed algorithms, energy efficiency, mobility. Virgile Garcia is finishing his PhD on distributed power management in cellular networks and Sandesh Uppoor is in his 2nd year on mobility models.

7.2. Actions Funded by the EC

7.2.1. Projet iPLAN - FP7-PEOPLE-IAPP-2008 (2009-2012, 440 keuros)

Participants: Jean-Marie Gorce, Guillaume Villemaud, Nikolaï Lebedev, Dmitry Umansky, Meiling Luo.

iPLAN (is a FP7 project of the FP7-PEOPLE-IAPP-2008 call. iPLAN (Indoor Planning) The iPlan consortium is made of the Ranplan Company, the CITI Lab- oratory and the University of Bedfordshire and proposes the study of Indoor planning and optimization models and tools. The aim is to develop fast and accurate radio propagation models, investigate various issues arising from the use of femtocells, develop an automatic indoor radio network planning and optimization and facilitate knowledge integration and transfer between project partners, to enable cross-fertilization between radio propagation modeling, wireless communications, operations research, computing, and software engineering.

Meiling is currently seconded full-time for 2 years in Ranplan Company, and Nikolai Lebedev is seconded full-time for 1 year.

7.2.2. DistMo4wNet - FP6 fellowship (2006-2011, 240 keuros)

Participants: Jean-Marie Gorce, Katia Jaffrès-Runser.
DistMo4wNet is a FP6 project labelled in the FP6 framework in the outgoing fellowship program. Jean-Marie Gorce is the scientific responsible of the program, and Katia Jaffres-Runser is the applicant. She was supported from January 2007 through June 2009, for two years at the Stevens Institute of Technology where she works with Pr. Cristina Comaniciu on distributed optimization of wireless networks protocols.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. LINCS


8.1.2. DigiTeo ACRON

Participant: Bartłomiej Błaszczyszyn.

Project Analyse et Conception de Réseaux Sans Fil Auto-Organisés (ACRON) started in 2011. Coordinator: Supélec (Télécommunications), Partners: Inria HIPERCOM, Université Paris-Sud, IEF. Trec is associated partner.

The objective of this project is to work on characterization of the fundamental performance limits of large self-organizing wireless networks and develop distributed and self-organizing communication techniques that will approach the theoretical limits.

8.2. National Initiatives

8.2.1. ARC OCOQS

Participant: Ana Bušić.

Two-year Inria Collaborative action Action de recherche collaborative (ARC) OCOQS “Optimal threshold policies in COntrolled Queuing Systems” OCOQS started in 2011. Coordinator: Ana Bušić, Participants: Alain Jean-Marie (MAESTRO, INRIA Sophia-Antipolis), Emmanuel Hyon (University of Paris Ouest and LIP6), Ingrid Vliegen (University of Twente); [http://www.di.ens.fr/~busic/OCOQS](http://www.di.ens.fr/~busic/OCOQS). The research subject is the optimal control of stochastic processes, with applications to the control of networks and manufacturing systems. The principal aim is to widen the set of mathematical techniques that can be used to prove that optimal policies are of threshold type, thereby widening the set of classes of models that can be effectively solved exactly or numerically handled in practice.

8.2.2. GdR Stochastic Geometry

Participants: François Baccelli, Bartłomiej Błaszczyszyn.

TREC has participated in the mounting of the Research Group (Groupement de recherche, GdR) on Stochastic Geometry led by Pierre Calka (Université de Rouen). This GdR is going to be a collaboration framework for all French research teams working in the domain of spatial stochastic modeling, both on theory development and in applications. This year the application has been accepted by the National Committee of CNRS and the group will be officially created in 2012.

8.2.3. PEPS INS2I MonoSimPa

Participants: Anne Bouillard, Ana Bušić.

Exploratory research (Projet Exploratoire Premier Soutien (PEPS)) of INS2I CNRS titled “Simulation Temps Parallèle, Simulation Parfaite et Monotonie” (MonoSimPa) is a one year exploratory project on parallel and perfect simulation. It is a joint project with PRiSM, Versailles (UMR 8144) and LIG, Grenoble (UMR 5217).
8.3. European Initiatives

8.3.1. Collaborations in European Programs FP7

Participant: All Trec.

European Network of Excellence (NoE), [http://euronf.enst.fr/en_accueil.html](http://euronf.enst.fr/en_accueil.html);
Project acronym: Euro-NF;
Duration: January 2008 - June 2012;
Coordinator: D. Kofman (Intitut Télécom);
Partners: about 30 partners;
Abstract: This NoE is focused on the next generation Internet. Its main target is to integrate the research effort of the partners to be a source of innovation and a think tank on possible scientific, technological and socio-economic trajectories towards the network of the future. Euro-NF is supported by the theme “Information and Communication Technologies (ICT)” under the 7th Framework Programme of the European Community for RTD. Euro-NF is a continuation of Euro-NGI

8.3.2. Collaborations in European Programs, except FP7

Participants: François Baccelli, Bartłomiej Błaszczyszyn, Marc Lelarge.

EIT ICT Labs Action Line: Internet Technologies and Architectures.
Project acronym: FUN
Project title: Fundamentals of Networking
Duration: January 2011 - December 2011
Coordinator: INRIA TREC
Partners: the partners are INRIA TREC and INRIA GANG (Fabien Mathieu) in France, VTT (Ilkka Norros, Samuli Aalto) and Aalto University (Pekka Orponen) in Finland, Eindhoven University (Sem Borst, Onno Boxma and Remco van der Hofstad) in the Netherlands.
Abstract: The aim of this project is to build a community of researchers focusing on fundamental theoretical issues of future networking. The topics of interest include: communication theory, network information theory, distributed algorithms, self-organization and game theory, modeling of large random and complex networks and structures. The proposal builds upon collaborations within the EURONF Network of Excellence, where the three institutions are partners and where the researchers have had fruitful scientific interactions.

8.4. International Initiatives

8.4.1. INRIA Associate Teams

8.4.1.1. IT-SG-WN

Title: Information Theory, Stochastic Geometry, Wireless Networks
INRIA principal investigator: François Baccelli
International Partner:

Institution: University of California Berkeley (United States)
Laboratory: EECS Department
Researcher: Venkat Anantharam, Anant Sahai, David Tse.

International Partner:
Institution: Stanford University (United States)
Laboratory: EE
Researcher: Abbas El Gamal.

Duration: 2011 - 2013
See also: http://www.di.ens.fr/~baccelli/IT_SG_WN_web_site.htm

The activity of this proposal is centered on the inter-play between stochastic geometry and network information theory, with a particular emphasis on wireless networks. In terms of research, three main lines of thought will be pursued:
1. Error exponents and stochastic geometry
2. Stochastic geometry and network Information Theory
3. Cognitive radio and stochastic geometry

8.4.2. Visits of International Scientists

8.4.2.1. Internships

Aleksander Wieczorek
Subject: Optimal control of an inventory system
Institution: Poznan University of Technology (Poland)

Mir Omid Haji Mirsadeghi (from Jan 2011 until Sep 2011)
Subject: Graph matching based on semi-definite positive relaxation
Institution: Sharif University of Technology (Iran, Islamic Republic of)
8. Partnerships and Cooperations

8.1. Technology Development Actions (ADT)

8.1.1. DAUM

**Participants:** Didier Vojtisek, Jean-émile Dartois, François Fouquet, Erwan Daubert, Noël Plouzeau.

DAUM is a Technology Development Action (ADT) by INRIA aiming at providing an integrated platform for distributed dynamically adaptable component based applications. DAUM unites and integrates results and software from the Triskell EPI and the Myriads EPI. More precisely, DAUM extends the Kevoree component framework designed by Triskell with adaptation mechanisms from the SAFDIS framework designed by Myriads.

DAUM will evaluate this integration by designing a full scale system for a tactical assistant for firefighter officers, in collaboration with the firefighters organization of Ille et Vilaine department (2800 firefighters).

**Project duration:** October 2011 - September 2012

**Triskell budget share:** One associated engineer shared with the Myriads EPI

**Project Coordinator:** Noël Plouzeau, Triskell INRIA Project.

**Participants:** Myriads, Triskell.

8.1.2. KerGekoz

**Participants:** Didier Vojtisek, Benoit Combemale, Olivier Barais, Clément Guy.

KerGekoz is an Technology Development Action (ADT) by INRIA which goal is to improve the Gecos platform of Cairn EPI by applying MDE technologies from Triskell EPI.

Gecos platform is a compiler infrastructure for the conception of System on Chip. Gecos integrates ASIP flow synthesis, automatic parallelisation and hardware synthesis (C to hardware).

This ADT focuses on

- consolidation of existing work,
- improvement of the reusability and maintainability by applying Kermeta MDE technologies.

Triskell EPI mainly works in collaboration with CAIRN to integrate Kermeta to the Gecos platform.

**Project duration:** 2010-2012

**Triskell budget share:** One associated engineer shared with CAIRN EPI

**Project Coordinator:** Steven Derrien, CAIRN INRIA Project.

**Participants:** CAIRN, TRISKELL.

8.2. Labex

8.2.1. Participation to Comin Labs

**Participants:** Johann Bourcier, Jean-Marc Jézéquel.
The Triskell project is involved in the Laboratory of excellence Comin Labs (Digital Communications and Informatics for the Future Internet) which involves various academics in French Brittany. The triskell team is mainly involved in the first challenge of Comin Labs: Digital Environment for the Citizen. Johann Bourcier has made an invited presentation about Software Engineering for Smart Cities at the first seminar of this challenge.

Project duration: 2011 - 2021

Participants: CNRS, Inserm, Université de Rennes 1, Université Rennes 2, Université de Bretagne Occidentale, Université de Bretagne Sud, Université de Nantes, Ecoles des Mines de Nantes, INSA de Rennes, ENS Cachan - antenne de Bretagne, Télécom Bretagne, Supelec, INRIA Rennes - Bretagne Atlantique.

8.3. National Initiatives

8.3.1. CNRS GDRs

The Triskell project is connected to the national academic community through a lightweight participation to several CNRS GDR (Groupement de Recherche).

- GDR GPL: Génie de la Programmation et du Logiciel (http://www-lsr.imag.fr/GPL), where Jean-Marc Jézéquel is a member of the scientific committee.
- Action IDM (on Model Driven Engineering) (http://www.actionidm.org), a transversal action (GDRs GPL, ASR and I3S).

The Triskell team also led an "Action Spécifique 2011 du GDR GPL" about software engineering for software intensive heterogeneous systems. Both the AOSTE and Triskell INRIA teams evolved in this project led by Benoit Combemale, and sharing a 5 keuros budget.

8.4. European Initiatives

8.4.1. ERCIM Working Group on Software Evolution

Numerous scientific studies of large-scale software systems have shown that the bulk of the total software-development cost is devoted to software maintenance. This is mainly due to the fact that software systems need to evolve continually to cope with ever-changing software requirements. Today, this is more than ever the case. Nevertheless, existing tools that try to provide support for evolution have many limitations. They are (programming) language dependent, not scalable, difficult to integrate with other tools, and they lack formal foundations.

The main goal of the proposed WG (http://w3.umh.ac.be/evol/) is to identify a set of formally-founded techniques and associated tools to support software developers with the common problems they encounter when evolving large and complex software systems. With this initiative, we plan to become a Virtual European Research and Training Centre on Software Evolution.

Triskell contributes to this working group on the following points:

- re-engineering and reverse engineering
- model-driven software engineering and model transformation
- impact analysis, effort estimation, cost prediction, evolution metrics
- traceability analysis and change propagation
- family and product-line engineering
8.5. International Initiatives

8.5.1. Standardization in Eclipse projects

In 2011, Triskell project participates to the creation of Polarsys (A New Industry Collaboration to Build Open Source Tools for Safety-Critical Software Development) at the Eclipse Foundation to focus on building and maintaining tools for safety critical and embedded system development.

8.5.2. Standardization at OMG

In 2011, Triskell project participates to normalization actions at OMG (http://www.omg.org/). It was involved in the CVL Common Variability Language Response to RFP and was interested in the Analysis and Design group which promotes standard modeling techniques including UML and MOF.

8.5.3. Collaboration with foreign research groups

- University of Zürich: Since 2010, Triskell has been working with the Requirements Engineering group on static analysis for model operations. Our work on metamodel footprint recovery has been published at ICSE [37]. We have started an empirical validation of this work with groups of students from Rennes and Zürich.

- University of Luxembourg: Since 2009 Triskell is involved in a collaborative project called SPLIT: Combine Software Product Line and Aspect-Oriented Software Development (with Nicolas Guelfi and Jacques Klein), that is funded by both the PICS program of CNRS and the FNR of Luxembourg. This project is providing the background and the funding for Paul Istoan’s PhD thesis, done in co-tutelle between University of Rennes and University of Luxembourg. As an initial research result, we showed how aspects can be unwoven, based on a precise traceability metamodel dedicated to aspect model weaving.

8.6. European Initiatives

8.6.1. FP7 Projects

8.6.1.1. DiVA

**Participants:** Jean-Marc Jézéquel, Benoit Baudry, Olivier Barais, Didier Vojtisek, Johann Bourcier, Arnaud Blouin.

The goal of DiVA is to provide a tool-supported methodology for managing dynamic variability of co-existing, co-dependent configurations in adaptive systems that span system administration and platform boundaries. Examples of such adaptive systems are communication infrastructure in rescue operations and mobile entertainment environments. This is addressed through a combination of aspect-oriented and model-driven techniques. DiVA explores how adaptation policies can be captured in the requirements, how aspects can model the variants used to adapt the system, how models can be kept at runtime to drive the adaptation and which validation techniques have to be developed in this context.

The Triskell team participates mainly in the definition of models that can drive the adaptation at runtime. The benefits of keeping models at runtime is to have an abstract view of the adaptation policies and mechanisms on which it is possible to reason (to check invariants, QoS properties, etc.) before actually adapting the running system. One important challenge tackled by Triskell is a mechanism to synchronize the running system with the model that has been adapted according to the changes in the environment. Triskell is also involved in the different validation tasks that occur when building such systems and when adapting these systems at runtime. An important issue for validation at design time is to select a subset of all possible configurations for testing. At design time, it is necessary to validate interactions between variants and to check that invariants on the system are satisfied.
The DiVA project has ended during the year 2011, with the final review in May. This project has been a real success as stated by the assessment of the final review: Excellent progress (the project has fully achieved its objectives and technical goals for the period and has even exceeded expectations).

Project duration: 2007-2011
Triskell budget share: 400 keuros
Project Coordinator: SINTEF
Participants: SINTEF, Uni. Lancaster, INRIA, Pure Systems, Thales IS, CAS.

8.6.1.2. S-CUBE

Title: S-CUBE
Type: COOPERATION (ICT)
Defi: Service & SW architectures, infrastructures and engineering
Instrument: Network of Excellence (NoE)
Duration: October 2008 - March 2012
Coordinator: University of Duisburg-Essen (Germany), Tilburg University (The Netherlands)
Others partners: Tilburg University (The Netherlands), City University London (UK), Consiglio Nazionale delle Ricerche (Italy), Center for Scientific and Technological Research, The French National Institute for Research in Computer Science and Control, Lero - The Irish Software Engineering Research Centre (Ireland), Politecnico di Milano (Italy), MTA SZTAKI - Computer and Automation Research Institute, Vienna University of Technology (Austria), Université Claude Bernard Lyon (France), University of Crete, Universidad Politécnica de Madrid (Spain), University of Stuttgart (Germany)
See also: http://www.s-cube-network.eu/
Abstract: S-Cube, the Software Services and Systems Network, will establish an integrated, multidisciplinary, vibrant research community which will enable Europe to lead the software-services revolution, thereby helping shape the software-service based Internet which is the backbone of our future interactive society.

An integration of research expertise and an intense collaboration of researchers in the field of software services and systems are needed to address the following key problems:

- Research fragmentation: Current research activities are fragmented and each research community (e.g., grid computing or software engineering) concentrates mostly on its own specific techniques, mechanisms and methodologies. As a result the proposed solutions are not aligned with or influenced by activities in related research fields.
- Future Challenges: One challenge, as an example, is to build service-based systems in such a way that they can self-adapt while guaranteeing the expected level of service quality. Such an adaptation can be required due to changes in a system’s environment or in response to predicted and unpredicted problems.

Triskell budget share: 150 keuros

8.6.1.3. NESSoS

Title: NESSoS
Type: COOPERATION (ICT)
Defi: Service & SW architectures, infrastructures and engineering
Instrument: Network of Excellence (NoE)
Duration: October 2010 - October 2014
Coordinator: CNR - Consiglio Nazionale delle Ricerche (Italy)

Others partners: ATOS (Spain), ETH (Switzerland), Katholieke Universiteit Leuven (Belgium), Ludwig-Maximilians-Universitaet Muenchen (Germany), IMDEA (Spain), INRIA (France), University of Duisburg-Essen (Germany), University of Malaga (Spain), University of Trento (Italy), SIEMENS (Germany), SINTEF (Norway)

See also: http://www.nessos-project.eu/

Abstract: The Network of Excellence on Engineering Secure Future Internet Software Services and Systems (NESSoS) aims at constituting and integrating a long lasting research community on engineering secure software-based services and systems. In light of the unique security requirements the Future Internet will expose, new results will be achieved by means of an integrated research, as to improve the necessary assurance level and to address risk and cost during the software development cycle in order to prioritize and manage investments. NESSoS will also impact training and education activities in Europe to grow a new generation of skilled researchers and practitioners in the area. NESSoS will collaborate with industrial stakeholders to improve the industry best practices and support a rapid growth of software-based service systems in the Future Internet.

Three INRIA EPIs are involved in NeSSoS: ARLES, CASSIS and Triskell. Triskell leads the research workpackage on design and architecture for secured future internet applications.

Triskell budget share: 100 keuros

8.6.1.4. CESAR

Title: CESAR

Duration: February 2009 - January 2012

Coordinator: AVL - GmbH (Austria)

See also: http://www.cesarproject.eu/

Abstract: In the context of CESAR, we have participated to the sub-project 3 demonstrator in order to demonstrate the usability of Polychrony as a co-simulation tool within the reference technology platform of the project, to which its open-source release has been integrated. The case-study, implemented in collaboration with Airbus and IRIT, consists of co-modeling the doors management system of an Airbus A350 by merging its architecture description, specified with AADL, with its behavioral description, specified with Simulink.

Triskell brings its model-driven engineering expertise to compositionally assemble, compile and verify heterogeneous specifications (AADL and Simulink). Our case study will cover code generation for real-time simulation and test as well as formal verification both at system-level and in a GALS framework. Based on that case study, we aim at developing further modular code-generation services, real-time simulation, test and performance evaluation, formal verification as well as the validation of the generated concurrent and distributed code.

8.6.1.5. Artemis CHESS

Participants: Noël Plouzeau, Jean-Marc Jézéquel, Jacques Falcou, Viet-Hoa Nguyen.

CHESS is an Artemis project that seeks industrial-quality research solutions to problems of property-preserving component assembly in real-time and dependable embedded systems, and supports the description, verification, and preservation of non-functional properties of software components at the abstract level of component design as well as at the execution level. CHESS develops model-driven solutions, integrates them in component-based execution frameworks, assesses their applicability from the perspective of multiple domains (such as space, railways, telecommunications and automotive), and verifies their performance through the elaboration of industrial use cases.
In 2011 Triskell contributed to the definition and development of the model editor specially built for CHESS on top of Papyrus. Triskell is also a contributor of model transformation tools, by adapting its Kermeta platform to the Chess process, and by contributing to the interconnection of external tools from industrial tool provider partners. Triskell is also the implementor of a set of constraint checkers, which ensure that designers define models compliant with the CHESS metamodel.

Project duration: 2/2009-4/2012
Triskell budget share: 400 keuros
Project budget: 6 M euros
Project Coordinator: INTECS
Participants: AICAS, Aonix, Atego ENEA, Ericsson, Fraunhofer, FZI, GMV, INRIA (Triskell), INTECS, Thales Alenia Space, THALES Communications, UPM, University of Padua, X/Open

8.6.2. Collaborations in European Programs, except FP7

Program: ITEA2
Project acronym: OPEES
Project title: Open Platform for the Engineering of Embedded Systems
Duration: 2010-2012
Triskell budget share: 150 keuros
Coordinator: OBEO (Gaël Blondelle)
Other partners: AIRBUS, ADACORE, Anyware Technologies, Astrium Satellites, Atos Origin, CEA LIST, CNES, C-S, Dassault, EADS Astrium ST, ENAC, INPT-IRIT; INRIA (Atlas-Mod/EXPRESSO/TRISKELL), MBDA, OBEO, ONERA, Schneider Electric, Thales, Xipp
Abstract: OPEES is an ITEA2 project which goal is to build a community able to ensure long-term availability of innovative engineering technologies in the domain of software-intensive embedded systems. Its main benefits should be to perpetuate the methods and tools for software development, minimize ownership costs, ensure independence of development platform, integrate, as soon as possible, methodological changes and advances made in academic world, be able to adapt tools to the process instead of the opposite, take into account qualification constraints. In this purpose, OPEES relies on the Eclipse Modeling Project platform (EMF, GEF, GMF, OCL, UML2, ...) and on many available tools such as Kermeta. The participation of Triskell into the OPEES project aims at industrializing both ModMap and Pramana. ModMap is a method and the associated tool to specify and use alignment rules between both homogeneous and heterogeneous languages. Current use is the creation of adapters between aligned languages. Pramana is a model transformation testing framework that makes it possible to synthesize input data (i.e. test models) for model transformations and check that the transformation behaves "correctly" on them.

Program: Marie Curie
Project acronym: Relate
Project title: Trans-European Research Training Network on Engineering and Provisioning of Service-Based Cloud Applications
Duration: February 2011 - January 2015
Triskell budget share: 730 keuros
Coordinator: Karlsruhe Institute of Technology
Other partners: Université de Rennes, IRISA (France); King’s College, (UK); South East European Research Center, SEERC (Greece); Charles University (Czech Republic); CAS Software (Germany); Singular Logic (Greece)
Abstract: The RELATE Initial Training Network aims to establish a network of international academic and industrial partners for a joint research training effort in the area of engineering and provisioning service-based cloud applications. The training is intended to not only shape high-level academic researchers, but also educate next generation experts and innovators in the European software industry. Through an integrative and multidisciplinary research approach, RELATE aims to promote the advancement of the state of the art in the related areas of model-driven engineering and formal methods, service-based mash-ups and application integration, security, performance, and trust in service-based cloud applications, and quality management and business model innovation.

8.7. International Initiatives

8.7.1. INRIA Associate Teams

8.7.1.1. MOCAA

Title: Models Composition, Aspects and Analysis

INRIA principal investigator: Benoît Baudry

International Partner:

Institution: Colorado State University (United States)
Laboratory: Colorado State University, Software Assurance Lab

Duration: 2006 - 2011

See also: http://www.irisa.fr/triskell/matt/

Computer-based systems have been growing in complexity at an exponential rate (roughly 10 fold increase every ten years) for more than 40 years. Like in other sciences, people have been relying more and more on modeling to try to master this complexity. Modeling, in the broadest sense, is indeed the cost-effective use of a simplified representation of an aspect of the world for a specific purpose. Because in software a model has the same nature as the thing it models, this opens the possibility to automatically derive software (and other artifacts such as test cases, performance profiles, or documentation) from its model. This property is well known from any compiler writer (and others), but it was recently be made quite popular with initiatives such as Model Integrated Computing (MIC) or OMG’s Unified Modeling Language (UML) and Model Driven Architecture (MDA), globally known as Model Driven Development (MDD). In this context, models are formally described and can be automatically manipulated for refinement, composition, test case generation, documentation; All those operations are model transformations. This collaboration aims at better understanding how classical software engineering practices (design patterns, validation, methods, IDEs) can be adapted to develop model transformations. Clément Guy worked in collaboration with Prof. Robert B. France (from the software engineering domain), as well as with Prof. Sanjay Rajopadhye (from the optimizing compiler domain) to cross-fertilize both domains. In particular, he was studying the possibility to extend existing model typing to fit the needs of reusing model transformations.

8.7.2. INRIA-CONFAP

Title: Software Testing for Cloud Computing (TAAS)

International Partner:

Universidade Federal do Paraná.

Principal investigator: Gerson Sunyé

Duration: 2011 - 2012
Cloud computing is consolidating as an important paradigm for information technology to provide resources and Internet-based services. In clouds, a large amount of resources (e.g., memory, CPU, disk) is shared between several storage and processing machines or nodes, providing scalable environments. However, building reliable applications for clouds is a difficult task, because developers must face several non-trivial issues, such as: large-scale distribution, fault tolerance, massive data processing, hardware and software heterogeneity. In general, a cloud involves clusters and grids of nodes distributed over the Internet, where each new node shares its resources with the rest of the system, ensuring the scalability of clouds.

Since cloud applications are becoming ubiquitous in society’s critical activities (health, economics, governments, etc.), they must ensure that the eventual failures of nodes do not affect the applications running on it. Large-scale distribution increases risks related to the loss of data because of nodes that fail, delay in computation times because of unreliable distribution strategy, etc. and several algorithms are proposed to increase their tolerance to faults. Thus, quality factors such as: reliability, robustness, availability and performance are essential. The main practice to ensure these factors, as well as the correctness, is the systematic use of testing during the different stages of development.

In this project, we propose to adapt and improve the testing architectures previously developed. More precisely, we propose to adapt the existing architecture for cloud environments, to define a testing language that supports the specification of large-scale tests as a whole and to provide both, a generator of test data and a fault injector, to reproduce real cloud environments.

8.7.3. INRIA International Partners
Following the Diva STREP project, we keep an active collaboration with the SINTEF institute. François Fouquet visited SINTEF for 8 weeks. During this visit, we combined the results of Kevoree and the result of the Moderate from SINTEF project to provide a dynamic component model for a micro-controllers based Internet of Things. Indeed, as the Internet of Things promises new ways for humans to interact with computing systems by seamlessly integrating resource constrained devices and traditional computing environment. These new computing environments are highly volatile and force applications to embed self-adaptive behaviors. The contribution of this collaboration is $\mu$-Kevoree: a plain C implementation of the Kevoree runtime which can be deployed on poor in resources micro-controllers. Evaluation of memory usage, reliability and performance shows that $\mu$-Kevoree is a viable solution with strong benefits over adaptation through dynamic firmware upgrades.

8.7.4. Visits of International Scientists
8.7.4.1. Internships
Hanen HAOUAS (from Mar 2011 until Aug 2011)
   Subject: Autonomously Optimizing Service-Based Application Dependability in Smart Building
   Institution: Ecole Nationale des Sciences de l’Informatique (Tunisia)

Wuliang Sun
   Subject: Discovering the boundaries of a Modelling Space
   Institution: Colorado State University (United States)

8.7.5. Participation In International Programs
Thanks to the MoCAA Equipe associée, Clément Guy realized a three-month stay in 2011 at Colorado State University (USA). He worked in collaboration with Prof. Robert B. France (from the software engineering domain), as well as with Prof. Sanjay Rajopadhye (from the optimizing compiler domain) to cross-fertilize both domains. In particular, he was studying the possibility to extend existing model typing to fit the needs of reusing model transformations.
8. Partnerships and Cooperations

8.1. Regional Initiatives

- **Modeling and rendering with distance functions**: This project is a collaboration between the ALICE / INRIA Nancy Grand-Est team and the Computer Graphics group of the Karlsruhe Institute of Technology (KIT). It is funded by INRIA Nancy Grand-Est for a 12 months period (COLORS grant) and serves as a first step in what we hope to become a continued collaboration between our teams.

8.2. National Initiatives

8.2.1. ANR projects

8.2.1.1. ANR Similar Cities

**Participants**: Samuel Hornus, Anass Lasram, Sylvain Lefebvre.

- Title: Similar Cities
- Principal Investigator: Sylvain Lefebvre (INRIA ALICE)
- Participants: INRIA Nancy, CSTB, Allegorithmic
- See also: GoodShape

**Abstract**: Similar Cities aims at enhancing the visual appearance of virtual cities, using procedural methods. Our key insight is to replace the numerous textures used to faithfully render large virtual cities by procedural equivalents. These procedural textures are thousands of times smaller but can still be quickly generated whenever required by the rendering engine. Our every-day tools for this research are procedural texture generators, texture synthesis by example, texture streaming algorithms and image processing tools.

8.2.1.2. ANR Physigraphics

**Participants**: Alejandro Galindo, Kun Liu, Rhaleb Zayer.

- Title: Physigraphics
- Principal Investigator: Rhaleb Zayer (INRIA ALICE)
- Instrument: ANR “chaire d’excellence” grant
- See also: Physigraphics

**Abstract**: Physigrafix is a research effort geared towards bridging the gap between acquisition and modeling in the context of deformable objects. The will project proceed on two complementary tracks. The first is the acquisition and tracking of deformable models, and the second is the mathematical modeling of the captured deformation behavior. The central idea is to rely on the exhibited physics to drive the mathematical model, in this way problems commonly encountered in simulation modeling can be avoided in the first place. This research is motivated by real world applications, and in a broad scope touches upon disciplines such as virtual medicine, manufacturing and feature film industry.
8.2.1.3. **ANR Morpho**

**Participants:** Dobrina Boltcheva, Phuong Ho, Bruno Lévy.

Title: Morpho

Coordinator: Edmond Boyer (INRIA MORPHEO)

Participants: LJK/INRIA Grenoble, INRIA Nancy/LORIA, GIPSA-Lab

See also: Morpho

Abstract: Morpho is aimed at designing new technologies for the measure and for the analysis of dynamic surface evolutions using visual data. The interest arises in several application domains where temporal surface deformations need to be captured and analyzed. It includes human body analyses but also extends to other deforming objects, sails for instance. Potential applications with human bodies are anyway numerous and important, from the identification of pathologies to the design of new prostheses. The project focus is therefore on human body shapes and their motions and on how to characterize them through new biometric models for analysis purposes

8.2.1.4. **ANR Moditere**

**Participant:** Dmitry Sokolov.

Title: Moditere

Coordinator: C. Gentil (LIRIS)

Participants: LIRIS Lyon, LE2I Dijon, LORIA/INRIA Nancy, PEP(Pôle Européen de Plasturgie d’Oyonnax).

Abstract: Moditere aims at developing new 3D modeling tools, that extend the editing capabilities of classical CAD/CAM representations (Splines) to new geometries, such as fractal objects.

8.3. European Initiatives

8.3.1. **FP7 Projet**

8.3.1.1. **GoodShape**

**Participants:** Thomas Jost, Bruno Lévy, David Lopez, Romain Merland, Vincent Nivoliers, Jeanne Pellerin, Nicolas Ray.

Title: Numerical Geometric Abstractions: from bits to equations

Type: IDEAS

Instrument: ERC Starting Grant (Starting)

Duration: August 2008 - July 2013

Coordinator: INRIA (France)

See also: GoodShape

Abstract: GOODSHAPE involves several fundamental aspects of 3D modelling and computer graphics. GOODSHAPE is taking a new approach to the classic, essential problem of sampling, or the digital representation of objects in a computer. This new approach proposes to simultaneously consider the problem of approximating the solution of a partial differential equation and the optimal sampling problem. The proposed approach, based on the theory of numerical optimization, is likely to lead to new algorithms, more efficient than existing methods. Possible applications are envisioned in inverse engineering and oil exploration.
8.4. International Initiatives

8.4.1. INRIA International Partners

8.4.1.1. Cooperation with Hong-Kong University

Participant: Bruno Lévy.

In the frame of the GOODSHAPE project, we cooperate with Hong-Kong university on Centroidal Voronoi Tesselations and their applications. Researchers and students from Nancy and Hong-Kong visit each other on a regular basis. This year (2011), we had the following common publications on optimal sampling, centroidal Voronoi tesselations and their variations [23], [20], [21].

8.4.1.2. Cooperation with Girona University (Spain)

Participant: Sylvain Lefebvre.

We continued our cooperation with Gustavo Patow (researcher) and Ismael Garcia (PhD student) of Girona University, Spain, on the topic of data structures for spatial caching on the GPU. This year, we published a common article in ACM Siggraph ASIA / ACM Transactions on Graphics [16].
8. Partnerships and Cooperations

8.1. Regional Initiatives


**Participants:** Laurence Danlos, Benoît Sagot, Chloé Braud, Marie Candito, Benoît Crabbé, Pascal Denis, Charlotte Roze, Pierre Magistry, Djamé Seddah, Juliette Thuilier, Éric Villemonte de La Clergerie.

Linguistics and related disciplines addressing language have achieved much progress in the last two decades but improved interdisciplinary communication and interaction can significantly boost this positive trend. The LabEx (excellency cluster) EFL (Empirical Foundations of Linguistics), launched in 2011 and head by Jacqueline Vaissière, opens new perspectives by adopting an integrative approach. It groups together some of the French leading research teams in theoretical and applied linguistics, in computational linguistics, and in psycholinguistics. Through collaborations with prestigious multidisciplinary institutions (CSLI, MIT, Max Planck Institute, SOAS...) the project aims at contributing to the creation of a Paris School of Linguistics, a novel and innovative interdisciplinary site where dialog among the language sciences can be fostered, with a special focus on empirical foundations and experimental methods and a valuable expertise on technology transfer and applications.

Alpage is a very active member of the LabEx EFL together with other linguistic teams we have been increasingly collaborating with: LLF (University Paris 7 & CNRS) for formal linguistics, LIPN (University Paris 13 & CNRS) for NLP, LPNCog (University Paris 5 & CNRS) LSCP (ENS, EHESS & CNRS) for psycholinguistics, MII (University Paris 4 & CNRS) for Iranian and Indian studies. Alpage resources and tools have already proven relevant for research at the junction of all these areas of linguistics, thus drawing a preview of what the LabEx is about: experimental linguistics (see Section 4.8). Moreover, the LabEx should provide Alpage with opportunities for collaborating with new teams, e.g., on language resource development with descriptive linguists (INALCO, for example).

Benoît Sagot is in charge of one of the 7 scientific “strands” of the LabEx EFL, namely the strand on Language Resources. Several other project members are in charge of research operations within 3 of these 7 strands (“Experimental grammar from a crosslinguistic perspective”, “Computational semantic analysis”, “Language Resources”).

8.2. National Initiatives

8.2.1. ANR project Sequoia (2009 – 2011)

**Participants:** Benoît Sagot, Pierre Boullier, Marie Candito, Benoît Crabbé, Pascal Denis, Éric Villemonte de La Clergerie, Djamé Seddah.

Alpage plays a major role in the ANR-funded project SEQUOIA, lead by Alexis Nasr (LIF, University of Marseille-Provence, former member of the Talana team at University Paris 7). This project aims at developing or adapting probabilistic parsing techniques in order to release a high-performance parser for French based on SYNTAX. It brings together specialists of NLP and specialists of Machine Learning, in a very fruitful way.

8.2.2. ANR project EDyLex (2010 – 2012)

**Participants:** Benoît Sagot [principal investigator], Rosa Stern, Laurence Danlos, Pascal Denis.
EDyLex is an ANR project (STIC/CONTINT) headed by Benoît Sagot. The focus of the project is the dynamic acquisition of new entries in existing lexical resources that are used in syntactic and semantic parsing systems: how to detect and qualify an unknown word or a new named entity in a text? How to associate it with phonetic, morphosyntactic, syntactic, semantic properties and information? Various complementary techniques will be explored and crossed (probabilistic and symbolic, corpus-based and rule-based...). Their application to the contents produced by the AFP news agency (Agence France-Presse) constitutes a context that is representative for the problems of incompleteness and lexical creativity: indexing, creation and maintainance of ontologies (location and person names, topics), both necessary for handling and organizing a massive information flow (over 4,000 news wires per day).

The participants of the project, besides Alpage, are the LIF (Université de Méditerranée), the LIMSI (CNRS team), two small companies, Syllabs and Vecsys Research, and the AFP.

8.2.3. “Investissements d’Avenir” project PACTE (2012 – 2014)

Participants: Benoît Sagot, Éric Villemonte de La Clergerie, Laurence Danlos.

PACTE (Projet d’Amélioration de la Capture TExtuelle) is an “Investissements d’Avenir” project sumbitted within the call “Technologies de numérisation et de valorisation des contenus culturels, scientifiques et éducatifs”. It has been accepted, and will start in early 2012

PACTE aims at improving the performance of textual capture processes (OCR, manual script recognition, manual capture, direct typing), using NLP tools relying on both statistical (n-gram-based, with scalability issues) and hybrid techniques (involving lexical knowledge and POS-tagging models). It addresses specifically the applicative domain of written heritage. The project takes place in a multilingual context, and therefore aims at developing as language-independent techniques as possible.

PACTE involves 3 companies (DIADEIS, main partner, as well as A2IA and Isako) as well as Alpage and the LIUM (University of Le Mans). It brings together business specialists, large-scale corpora, lexical resources, as well as the scientific and technical expertise required.

8.3. European Initiatives

8.3.1. French-German ANR project Pergram (2009 – 2011)

Participant: Benoît Sagot.

The Pergram project (French-German ANR/DFG project) is lead by Pollet Sanvelian (University Paris 3). Its goal is the description of central phenomena in Persian and the development of a non-trivial grammar fragment in the framework of HPSG. The development of this grammar will benefit from the expertise of the German side on phenomena that are not found in French or English, such as scrambling, but will also deal with Persian-specific phenomena such as complex noun-verb predicates. In parallel, the project includes the development of various lexical resources, thanks in part to techniques and tools developed by Alpage members within the Alexina framework: (i) a full form lexicon of verbs and common nouns, for which a first version is now available, (ii) valency frames for verbs (iii) the most common Light Verb Constructions (LVCs) and including idiomatic preverb light verb combinations.

8.3.2. French-Slovene bilateral project “Building Slovene-French Linguistic Ressources” (2010 – 2011)

Participant: Benoît Sagot [principal investigator, jointly with Mojca Schlamberger-Brezar].

The objective of this project, jointly lead by Benoît Sagot (Alpage) and Mojca Schlamberger-Brezar (University of Ljubljana) is the development of multilingual linguistic resources for Slovene and French. The French funding is provided by EGIDE. The project is organized around two main goals: the development of a French-Slovene aligned and morphosyntactically annotated corpus, and the extension using semi-automatic techniques (automatic and manual validation construction) of the WOLF and of SloWNet, the wordnets for both languages. All these resources will be made available to the community by a distribution under a free license (e.g., LGPL-LR).
8.4. International Initiatives

8.4.1. ISO subcommittee TC37 SC4 on “Language Resources Management”

Participant: Éric Villemonte de La Clergerie.

The participation of ALPAGE to French Technolangue action Normalangue has resulted in a strong implication in ISO subcommittee TC37 SC4 on “Language Resources Management”. Éric de La Clergerie has participated to ISO events and has played a role of expert (in particular on morpho-syntactic annotations [MAF], feature structures [FSR & new FSD], and syntactic annotations [SynAF]).
ARIANA Project-Team

8. Partnerships and Cooperations

8.1. National Actions

8.1.1. ARC DADA : Description et Analyse Dynamique de la Croissance Axonale.
Participants: Xavier Descombes [PI], Laure Blanc-Féraud, Alejandro Mottini, Huei-Fang Yang, Florence Besse.
In collaboration with Serpico, INRIA Rennes - Bretagne Atlantique (C. Kervrann, P. Houllier).

8.1.2. ANR DIAMOND
Participants: Saima Ben Hadj, Laure Blanc-Féraud, Josiane Zerubia [PI].
In collaboration with the Pasteur Institute, the MIPS laboratory of Université de Haute Alsace, the LIGM of Université Paris-Est, and INRA Sophia-Antipolis. Web site: http://www-syscom.univ-mlv.fr/ANRDIAMOND

8.1.3. ANR MOTIMO
Participants: Gilles Aubert, Didier Auroux, Xavier Descombes, Eric Debreuve, Laure Blanc-Féraud [contact].
In collaboration with l’Institut de Mathématiques de Toulouse, l’INRA, l’Institut de Mécanique des Fluides de Toulouse, le Laboratoire d’Informatique, Signaux et Systèmes de Sophia-Antipolis, et IMV Technologies (PME).

8.1.4. PEP II : Analyse morphométrique des réseaux micro-vasculaires et neuronaux
Participants: Florence Besse, Eric Debreuve, Laure Blanc-Féraud, Xavier Descombes [PI].
In collaboration with IBDC (Nice), CerCo (Toulouse) and IMFT (Toulouse).

8.1.5. PEP II M2S
Participants: Xavier Descombes, Eric Debreuve, Giles Aubert, Didier Auroux, Laure Blanc-Féraud [contact].
In collaboration with l’Institut de Mathématiques de Toulouse, l’INRA, le Laboratoire d’Informatique, Signaux et Systèmes de Sophia-Antipolis.

8.1.6. GDR ISIS young researcher project on “scene analysis from Lidar”
Participant: Florent Lafarge [PI].
In collaboration with Clément Mallet and Bruno Vallet from MATIS Laboratory, IGN [http://www.ign.fr].
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR Tosa CityVIP

Participants: Patrick Rives, Andrew Comport, Maxime Meilland.

This project, in the continuation of the "Automated Road Scenario", focuses on low speed applications (<30 km/h) in an open, or partly open, urban context. The level of automatization can vary from limited driving assistance to full autonomy. An important effort is devoted to the use of on-board vision for precise vehicle localization and for urban environment modeling. This model is then used for automatic guidance by applying visual servoing techniques developed by the research partners.

Our partners are Lasmea (Clermont Ferrand), IRISA/Lagadic (Rennes), Heudiasyc (Compiègne), LCPC (Nantes), IGN/Matis (Paris), Xlim (Limoges), BeNonad (Sophia Antipolis)

8.1.2. Inria Large Scale Initiative Action PAL (Personaly Assisted Living)

Participants: Patrick Rives, Pascal Morin, Luca Marchetti.

ARobAS participates in the Large-scale initiative action Personally Assisted Living to develop technologies and services to improve the autonomy and quality of life for elderly and fragile persons. The purpose of LSIA PAL is to provide an experimental infrastructure, in order to facilitate the development of models, tools, technologies and concept demonstrations. Using the skills and objectives of the involved teams, four research themes have been defined: Assessing the degree of frailty of the elderly, Mobility of people, Rehabilitation, transfer and assistance in walking, and Social interaction. We are currently involved in the themes "Mobility of people" and "assistance in walking" through collaborations with the EPI Emotion and the Laboratoire "Handibio" (Toulon).

8.2. European Initiatives

8.2.1. Major European Organizations with which you have followed Collaborations

Instituto Superior Technico of Lisbon (Portugal);
Visual Slam and visual servoing of aerial vehicles.

8.3. International Initiatives

8.3.1. Visits of International Scientists

8.3.1.1. Internship

Wladyslaw Magiera a PhD student from the Institute of Computer Engineering, Control and Robotics, Wroclaw University of technology, Poland, has joined the team for three months from October 3 to December 2.

8.3.2. Participation in other International Programs

As a follow up to the long time collaboration between EPI A RobAS and the CTI/ in Campinas (Brazil), the project MuNave was accepted for funding in the INRIA/CNPq Collaboration framework (2010-2012). This project aims at investigating new research themes in perception and control for autonomous mobile robots. This year, one researcher of CTI has spent two weeks at INRIA. The visit of A RobAS members at CTI is planned during the first quarter of next year.
ARTIS Project-Team

8. Partnerships and Cooperations

8.1. ANR Blanc: ALTA

**Participants:** Nicolas Holzschuch [contact], Cyril Soler.

We are funded by the ANR research program "Blanc" for a joint research project with two other INRIA research teams, REVES in Sophia-Antipolis and iPARLA in Bordeaux. The goal of this project is studying light transport operators for global illumination, both in terms of frequency analysis and dimensional analysis. The grant started in October 2011, for 48 months.

8.2. ANR MDCO: ATROCO

**Participants:** Nicolas Holzschuch, Charles de Rousiers.

We are funded by the MDCO (Large Datasets and Knowledge) research program of the ANR, for a joint research project with the LIRIS research laboratory (Lyon) and the LSII research laboratory (Strasbourg), on acquisition, rendering and relighting of real objects for their inclusion in virtual scenes. This grant started in September 2007, for 36 months, and has been extended for 12 additional months.

8.3. ANR RIAM: CHEVEUX

**Participant:** Joëlle Thollot.

We are funded by the ANR research program RIAM (grants in multimedia projects) for a joint industrial project with two production studios: Neomis Animation and BeeLight, two other INRIA project-teams: Bipop and Evasion and a CNRS lab (Institut Jean Le Rond d’Alembert de l’Université Pierre et Marie Curie). The goal of this project is to provide rendering and animating tools for hairs for movie making. The grant started in September 2007, for 36 month.

8.4. ANR jeune chercheur: Animaré

**Participants:** Pierre Bénard, Pierre-Edouard Landes, Joëlle Thollot.

We are funded by the ANR research program “jeune chercheur” (grants for young research leaders) for a joint research project with the IPARLA INRIA project-team in Bordeaux. The goal is to develop expressive rendering models for 2D and 3D animations. The grant started in September 2007, for 36 month.

8.5. ANR jeune chercheur: SimOne

**Participants:** Fabrice Neyret, Cyril Soler, Manuel Vennier.

We are funded by the ANR research program “jeune chercheur” (grants for young research leaders) for a joint research project with the EVASION INRIA project-team. The goal of this project is to develop “Scalable Interactive Models Of Nature on Earth” (including shape, motion and illumination models for ocean, clouds, and vegetation). The grant started in December 2010, for 36 months.

8.6. ANR CONTINT: RTIGE

**Participants:** Eric Bruneton, Jean-Dominique Gascuel, Nicolas Holzschuch, Fabrice Neyret.

RTIGE stands for Real-Time and Interactive Galaxy for Edutainment. This is an ANR CONTINT (Contents and Interactions) research program, for a joint research project with the EVASION INRIA project-team, the GEPI and LERMA research teams at Paris Observatory, and the RSA Cosmos company. We aim at integrating our results for digital planetariums. The grant started in December 2010, for 48 months.
8.7. ANR COSINUS: ROMMA

**Participants:** Georges-Pierre Bonneau, François Jourdes.

The ANR project ROMMA has been accepted in 2009. It started in January 2010 for a duration of 4 years. The partners of this project are academic and industry experts in mechanical engineering, numerical simulation, geometric modeling, and computer graphics. The aim of the project is to efficiently and robustly model very complex mechanical assemblies. We work on the interactive computation of contacts between mechanical parts using GPU techniques. We also investigate the Visualization of data with uncertainty, applied in the context of the project.

8.8. LIMA

LIMA (Loisirs et Images Numériques) is a project from the Cluster ISLE (Informatique, Signal et Logiciel Embarqué). The ARTIS team is part of the LIMA project, and cooperates with other teams in the project for Numerical Images.

8.9. Exploradoc grant at Cornell University

**Participant:** Laurent Belcour.

The Région Rhône-Alpes has established a program to help PhD students initiating international collaboration during their PhD, with support for a six months stay in a lab in foreign university.

Laurent Belcour was funded for a six months stay at Cornell University, to work on real-time lighting and rendering algorithms.

8.10. International Initiatives

8.10.1. INRIA Associate Teams

8.10.1.1. CIPRUS

**Title:** Challenges in Photorealistic Rendering

**INRIA principal investigator:** Nicolas Holzschuch

**International Partner:**

- **Institution:** Cornell University (United States)
  **Laboratory:** Program of Computer Graphics Cornell University

**International Partner:**

- **Institution:** Massachusetts Institute of Technology (United States)
  **Laboratory:** Computer graphics group CSAIL Lab

**Duration:** 2009 - 2011

See also: [http://artis.imag.fr/Projets/Cornell-EA/](http://artis.imag.fr/Projets/Cornell-EA/) Photorealistic rendering deals with the production of pictures of virtual worlds that are as close as possible to what a real photograph of this virtual world would look like. Considerable progress has been made in recent years, and photorealistic pictures are being used in several sectors of the industry: virtual prototyping, special effects for motion picture, video games... However, truly photorealistic pictures of a virtual world are still difficult to get. There are multiple difficulties to overcome: model acquisition, model representation, scalability, sampling and perceptual issues. Our goal in this project is to address all these issues simultaneously, targetting the production of high-quality photographic like pictures that are capable of passing a "Turing-test": they are impossible to separate from photographs of the real world, with all its complexity.
Our goal in this project is to address the many hard challenges remaining in Photorealistic Rendering, especially dealing with the inclusion of real-world objects in virtual scenes and modelling complex materials, such as low-order scattering or high-reflectance materials. The challenges we selected have two points in common: they’re regarded as difficult research challenges, and they would greatly enhance the realism of the pictures generated. Both teams stand to gain from a joint work in this area. This joint work should result in several scientific breakthroughs, with the production of photorealistic pictures of highly complex virtual worlds.

8.10.2. Visits of International Scientists

- Professor Charles Hansen has started in November 2011 a visit of six months in the ARTIS team. His six-months visit is funded by the University of Grenoble. Charles D. Hansen received a BS in computer science from Memphis State University in 1981 and a PhD in computer science from the University of Utah in 1987. He is a professor of computer science at the University of Utah and an associate director of the SCI Institute. From 1989 to 1997, he was a Technical Staff Member in the Advanced Computing Laboratory (ACL) located at Los Alamos National Laboratory, where he formed and directed the visualization efforts in the ACL. He was a Bourse de Chateaubriand PostDoc Fellow at INRIA, Rocquencourt France, in 1987 and 1988. His research interests include large-scale scientific visualization and computer graphics.

- Professor Vijay Natarajan visits the ARTIS and EVASION teams for one month in November 2011. Following a visit of G.-P. Bonneau and S. Hahmann (from EVASION), in February 2010, he collaborated with these two faculties on the topic of topology-based visualization algorithms. A common paper was already published by these authors at IEEE TVCG in 2010. Vijay Natarajan is an professor in the Department of Computer Science and Automation and the Supercomputer Education and Research Centre at the Indian Institute of Science, Bangalore. He received the Ph.D. degree in computer science from Duke University in 2004 and holds the B.E. degree in computer science and M.Sc. degree in mathematics from Birla Institute of Technology and Science, Pilani, India. His research interests include scientific visualization, computational geometry, computational topology, and meshing.
AVIZ Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR Fitoc: From Individual To Collaborative Visual Analytics

Participants: Petra Isenberg [correspondant], Jean-Daniel Fekete, Pierre Dragicevic.

The project addresses fundamental problems of technological infrastructure and the design of data representation and interaction to build a bridge between individual and team work for visual data analysis. We will tackle this challenge through a stream of interconnected research modules, starting from fundamentally extending visualization toolkits for collaborative work and researching the necessary interaction and visualization mechanisms that will allow for a seamless and effortless setup of face-to-face data analysis with visualizations. We will provide both fundamental and applied contributions and evaluate our work in order to ensure its validity.

7.1.2. CSDL, Complex Systems Design Lab.

Participants: Nadia Boukhelifa, Waldo Cancino, Jean-Daniel Fekete, Evelyne Lutton [correspondant].

CSDL, Complex Systems Design Lab (2009–2012) is a project of the System@tic pole whose main contractor is Dassault Aviation, together with 27 academic and industrial partners. The aim of CSDL is to settle a complete collaborative environment for decision making in the framework of complex systems design (http://www.teratec.eu/activites/projetsR_D_systematic.html). CSDL funds have been used to hire a two post-doctoral researchers (Nadia Boukhelifa and Waldo Cancino).

7.2. Avenir: Advanced Visual Exploration with Non-photorealistic and Interactive Rendering

Participants: Tobias Isenberg, Jean-Daniel Fekete [correspondant], Pierre Dragicevic.

AVIZ and CNRS/LIMSI have invited Tobias Isenberg on a Digiteo Chair of Excellence, a very prestigious and competitive position offered by the Digiteo Consortium on the Saclay area. Tobias will be collaborating with both teams on a project call AVENIR: “Advanced Visual Exploration with Non-photorealistic and Interactive Rendering”.

This project will take a unique research approach to visualization that is situated at the intersection of several related directions: scientific and information visualization, non-photorealistic and illustrative rendering, and interaction on large displays. It aims to establish this area as a new research direction within the scope of the newly emerging domain of illustrative visualization which takes inspiration both from traditional illustration and computer-driven visualization. For this purpose we will investigate how to integrate both direct-touch interaction and non-photorealistic rendering into traditional scientific and information visualization applications.

On the one side, we will use techniques from non-photorealistic and illustrative rendering to provide abstraction and emphasis as well as make use of its ability to provide clear and understandable depictions. In addition, we will investigate the possibility for data reduction. Some non-photorealistic techniques can provide faster rendering than their photorealistic counterparts and can, thus, inspired the transfer of these techniques to visualization applications. This will greatly improve the visualization of large amounts of data.

On the other side, we will use direct-touch interaction on large displays to provide an intuitive and easily approachable platform for integrated visualization applications that allow the exploration of the large amounts of data we want to visualize. This specific setting not only allows a person to interact with a visualization in a very direct way but also affords collaborative visualization for small groups of scientists. This will create synergies from discussions between colleagues or in the context of small research teams which otherwise would not be possible for a single person.
This integration of visualization with non-photorealistic rendering and large-display interaction will not only integrate well with existing research directions of the two participating Digiteo teams, but also provide them with exciting new application domains: it will use concepts from both scientific visualization (VENISE) and information visualization (AVIZ) and will apply large display concepts (VENISE). Through this collaboration this grant will lead the way toward a new way of presenting and exploring scientific data.

7.3. European Initiatives

7.3.1. FP7 Project

Program: FP7
Project acronym: DREAM
Project title: Design and development of REAlistic food Models with well-characterised micro- and macro-structure and composition
Duration: 2009–2013
Coordinator: INRA - CEPIA department, Monique Axelos

Other partners: Technical Research Centre of Finland, Actilait France, ADRIA Développement France, CNRS, INRA Transfert, Société de Recherche et Développement Alimentaire Bongrain, Campden BRI Magyarország Nonprofit Kft. Hungary, Central Food Research Institute Hungary, Teagasc - Agriculture and Food Development Authority Ireland, Consiglio Nazionale delle Ricerche - Istituto di Scienze delle Produzioni Alimentari Italy, Top Institute Food and Nutrition The Netherlands, Wageningen University (WUR) The Netherlands, University of Ljubljana, Biotechnical Faculty Slovenia, Institute for Food and Agricultural Research and Technology Spain, Campden BRI UK, Institute of Food Research UK, United Biscuits (UK) Limited.

Abstract:
The overall goal of DREAM (Design and development of REAlistic food Models with well-characterised micro- and macro-structure and composition) is to develop realistic, physical and mathematical models to be used as standards that can be exploited across all major food categories to facilitate development of common approaches to risk assessment and nutritional quality for food research and industry.

The partnership involves 18 partners from 9 european countries, among which two multinationals. The project is lead by INRA, CEPIA department, and INRIA participation is managed by delegation by the ISC-PIF (CNRS-CREA, UMR 7656).

See more on http://dream.aaeuropae.org/.

Program: Infrastructures
Project acronym: CENDARI
Project title: Collaborative EuropeaN Digital/Archival Infrastructure
Duration: 01/2012 - 12/2015
Coordinator: Trinity College, Dublin (IE),

Other partners: Freie Universitaet Berlin (DE), Matematicki Institut Sanu u Beogradu (Serbia), University of Birmingham (UK), King’s College London (UK), Georg-August-Universitaet Goettingen Stiftung Oeffentlichen Rechts (DE), Narodni Knihovna Ceske Republiky (Czech Republic), Societa Internazionale per lo Studio del Medioevo Latino-S.I.S.M.E.L. Associazione (IT), Fondazione Ezio Franceschini Onlus (IT), Ministerium fur Wissenschaft, Forschung und Kunst Baden-Wurttemberg (DE), Consortium of European Research Libraries (UK), Koninklijke Bibliotheek (NL), UNIVERSITÀ DEGLI STUDI DI CASSINO (IT).
Abstract:

The Collaborative EuropeaN Digital Archive Infrastructure (CENDARI) will provide and facilitate access to existing archives and resources in Europe for the study of medieval and modern European history through the development of an ‘enquiry environment’. This environment will increase access to records of historic importance across the European Research Area, creating a powerful new platform for accessing and investigating historical data in a transnational fashion overcoming the national and institutional data silos that now exist. It will leverage the power of the European infrastructure for Digital Humanities (DARIAH) bringing these technical experts together with leading historians and existing research infrastructures (archives, libraries and individual digital projects) within a programme of technical research informed by cutting edge reflection on the impact of the digital age on scholarly practice.

The enquiry environment that is at the heart of this proposal will create new ways to discover meaning, a methodology not just of scale but of kind. It will create tools and workspaces that allow researchers to engage with large data sets via federated multilingual searches across heterogeneous resources while defining workflows enabling the creation of personalized research environments, shared research and teaching spaces, and annotation trails, amongst other features. This will be facilitated by multilingual authority lists of named entities (people, places, events) that will harness user involvement to add intelligence to the system. Moreover, it will develop new visual paradigms for the exploration of patterns generated by the system, from knowledge transfer and dissemination, to language usage and shifts, to the advancement and diffusion of ideas.

7.3.2. Major European Organizations with which you have followed Collaborations

Fraunhofer IGD: Fraunhofer Institute, IGD (DE)
We are collaborating on visual analytics, setting up European projects and coordinating European initiatives on the subject.

Jarke van Wijk: Eindhoven University of Technology, Department of Mathematics and Computer Science (NL)
We have been collaborating on the readability of visual links and we [23] and on the VisMaster European project.

7.4. International Initiatives

7.4.1. INRIA International Partners

INRIA researchers collaborate with a number of international partners, including:

- Google, Mountain View, USA
- Microsoft Research, Redmond, USA
- New York University, USA
- North Carolina State University, USA
- OCAD University, Toronto
- Purdue University, USA
- University of Calgary, Canada
- University of Eindhoven, The Netherlands
- University of Kaiserslautern, Germany
- University of Kent, UK
- University of Konstanz, Germany
- University of Magdeburg, Germany
- University of Manitoba, Canada
7.4.2. Visits of International Scientists

AVIZ is hosted the following international researchers for multi-week research stays:

- Pourang Irani (University of Manitoba, Canada)
- Nathaly Henry-Riche (Microsoft Research, USA)
- Claudio Silva (University of Utah / now New York University, USA)
- Juliana Freire (University of Utah / now New York University, USA)

AVIZ organized hosted the following international visitors for a one-day visit:

- Michael McGuffin (École de technologie supérieure, Canada)
- Catherine Plaisant (University of Maryland, USA)
- Georges Grinstein (University of Massachusetts Lowell, USA)
- Raimund Dachselt (University of Magdeburg, Germany)
- Koji Yatani (University of Toronto, Canada)

7.4.2.1. Internship

AVIZ is hosted the following international interns in 2011:

- Stefanie Klum (University of Magdeburg, Germany)
- Luana Micallef (University of Kent, UK)
6. Partnerships and Cooperations

6.1. Regional Initiatives

6.1.1. ADEME TIC TAC (2010 - 2012)

**Participants:** Anne-Laure Negri, Caroline Tiffon, Bernard Senach, Brigitte Trousse.

**Title:** TIC TAC

**Type:** PREDIT groupe 3, Mobilité dans les régions urbaines

**Challenge:** Technologies de l’Information et de la Communication – Transports Assemblés Cohérents

**Instrument:** Mobilité dans les régions urbaines

**Duration:** 2010 - March 2012

**Coordinator:** VuLOG

**Others partners:** MHC Conseil, CETE Méditerranée, CASA

**See also:** Technologies [http://www.projetictac.org/]

**Abstract:** TICTAC project aims to provide an advanced travellers’ information system in which real time information about waiting time at bus stop will be provided: users define their “favourite” and can call a vocal server which give them immediately the requested information.

This year we first participated in a study of current trends in urban mobility Real-ime MultiModal Information Systems (RTMMIS) conducted by CETE méditerannée [28]. After identifying the usage scenario [75], [74] and participating in the specification of the prototype [76], we specified the experiment of the first prototype developed by VuLOG in [77] and reported results of our usage analysis in a deliverable [78]. See also 7.1.1.

6.1.2. PACALABS HOTEL-REF-PACA (2010 - 2012)

**Participants:** Florian Bonacina, Bernard Senach, Brigitte Trousse, Yves Lechevallier, Nicolas Béchet, Ehab Hassan.

**Title:** HOTEL-REF-PACA

**Type:** Pacalabs

**Challenge:** Referencing of Web Sites for accommodation in Paca

**Instrument:** Pacalabs (Paca Region and FEDEPacalabsR fundings)

**Duration:** October 2010 - May 2012

**Coordinator:** Full Performance

**Others partners:** General Council of Maritim Alps

This project is conducted with Full Performance, a SME specialized in Web site referencing. It aims at improving hinterland tourism, hotel-keepers and tourists are involved in the experimentation. Experiments of different new referencing rules are conducted with Web site visitors in order to study their effect on behavioral changes and on touristic choices. The experimentation consists in three stages: current referencing rules are first studied and their efficiency estimated through eye-tracking experiments. Then new rules are explored and tested with users. When the convenient new rules are selected, their efficiency is evaluated through data mining analysis and qualitative studies.
This year we evaluated the ergonomics of 19 Web sites of hotels associated to our project and we formulated several recommendations according types of Web sites [72], [73]. We then formalised the know-how of the SME in referencing Web sites. Due to some delay in the experiment (mainly tag installation, data access), our data analysis task has been postponed to May 2012.

6.1.3. PACALABS ECOFFICES (2010 - 2011)

Participants: Guillaume Pilot, Yves Lechevallier, Bernard Senach, Brigitte Trousse.

Title: ECOFFICES
Type: Pacalabs
Challenge: Energy Challenge within Offices
Instrument: Pacalabs (Paca Region and FEDER fundings)
Duration: August 2010 - November 2011
Coordinator: Osmose
Others partners: CASA, CSTB
See also: http://www.ecoffices.com/

Abstract: ECOFFICES is an eco-challenge within an enterprise: offices are equipped with sensors and actuators. Actions of employees on actuators are registered and consumption behaviors are tracked. The experimentation consists in three successive stages: data are first recorded during the usual work of the challengers, then feedback is provided through user interface and in the challenge phase, 3 teams are competing to reach the best economy level. After the challenge, data are registered to study the change of practices, if any. The goal of the project is to provoke behavioral changes and our team is in charge of the evaluation.

This year we have elaborated the first experimentation protocol [59] for the original concept of eco-challenge within an enterprise. Due to some delay in the challenge (which ended September 30), the end of our contract has been delayed until November 2011 in order to have enough time for data analysis [80], [61], [62]. We also co-organized three open days at CSTB and have an active dissemination activity [79] in two European conferences [27], [68] and the World Usability Day [60].

6.1.4. CPER Telius (2007 - 2013) and ICT Usage Lab

This grant, funded by regional and European support, covers our experimental platform supporting usage data gathering and analysis of individual and collective usage of information systems. Such an experimental platform called Focus was renamed FocusLab (to avoid the ambiguity with a new Inria team) (cf. section 5.5.2). FocusLab is an experimental platform proposed for supporting collecting and analysing individual or collective usage data. This platform will be part of the infrastructure of the living lab ICT Usage Lab. This year ICT Usage lab was again member of EnOLL, the European network of living labs (composed of 274 living labs after 5th wave).

6.2. National Initiatives

6.2.1. ANR MIDAS (2008 - 2011)

Participants: Brigitte Trousse [correspondant], Chongsheng Zhang, Mohamed Gaieb.

Title: MIDAS
Type: ANR
Challenge: Summarizing and Analysing Data Streams
Instrument: MDCO
Duration: 2008 - 2011
Coordinator: Telecom Paris Tech
Others partners: Ceregmia, EDF, France Telecom R&D, LIRMM, Telecom ParisTech

Abstract: The MIDAS project aims at studying, developing and demonstrating new methods for summarizing data streams. It tackles the following scientific challenges related to the construction of summaries.
Our source code has been integrated in the MIDAS demonstrator based on Esper, a component for complex event processing and Postgres as well as our two applications [66], [67], [57]. Two videos have been prepared by B. Trousse for ANR STIC conference (January 2012).

In 2011, we demonstrated the use of the SCDS MIDAS approach [11] to summarize data streams on two applications for the ANR STIC conference (Lyon, december):

- Vehicle trajectories (Brinkhoff generator http://iapg.jade-hs.de/personen/brinkhoff/generator/ in the context of MIDAS project (Java version))
- Orange mobile portal logs (100 million records, 3 months) in the context of Midas project (Java version) and the CRE (Orange C++ version)

C. Zhang’s thesis has been partially funded by MIDAS [19] (cf. section 5.2).

6.2.2. Web 2.0 SCAR (2009 - 2011)

**Participants:** Florian Bonacina, Anne-Laure Negri, Bernard Senach, Brigitte Trousse.

- **Title:** SCAR
- **Type:** Web 2.0
- **Challenge:** Collaborative and Adaptable Recommender system
- **Instrument:** Web based Innovative Service
- **Duration:** 2009 - 2011
- **Coordinator:** Wozaik
- **Others partners:** INRIA

**Abstract:** The goal of the Scar project is to provide to users of an advanced bookmarking system such as a recommender based on social

A state-of-the-art of tools related to the management task of bookmarks with a cognitive approach have been done.

6.2.3. Process 2.0 (2009 - 2011)

**Participants:** Pascal Marie-Dessoude, Dominique Scapin [correspondant].

- **Title:** Process 2.0
- **Type:** DGCSI
- **Challenge:** Citizen-oriented e-Gov Tool
- **Instrument:** Innovative Web
- **Duration:** 2009 - 2011
- **Coordinator:** Genigraph
- **Others partners:** LIESP (via INSAVALOR), Petals link (ex EBM Websourcing), Région Midi-Pyrénées

**Abstract:** Process 2.0 Project proposes to consider the collaborative process as a composition of business services, “drawn” by end users through a collaborative design studio process that supports a multi-faceted modeling and integration of patterns.

This year, a set of specifications for collaborative work was produced [63], and the project ended with the ergonomic evaluation of the e-Citiz tool [64].
6.2.4. ANR MyCitizSpace (2007 - 2011)

Participants: Pascal Marie-Dessoude, Dominique Scapin [correspondant].

Title: MyCitizSpace
Type: ANR
Challenge: e-gov tool and personal information
Instrument: RNTL
Duration: 2007 - 2011
Coordinator: Genigraph
Others partners: LIG (HCI team) Grenoble, IRIT Toulouse, Genigraph, Almetis, DRTEFP d’Ile de France, Région Midi-Pyrénées
See also: http://genibeans.com/cgi-bin/twiki/view/MyCitizSpace/PresentationDuProjet

Abstract: “Méthode et outils de conception basés sur une approche d’Ingenierie Dirigée par les Modèles (IDM) pour l’exécution distribuée des téléprocédures plastiques à espace de données personnelles sécurisé” aims at the design of a method and tools based on a Model-Driven Architecture for the distributed execution of plastic teleprocedures incorporating a secure personal data space, making the electronic procedures between the administrations and the citizen the most seamless possible.

This year, the project ended with the ergonomic evaluation of the e-Citiz tool [65].

6.2.5. ANR PIMI (2010 - 2013)

Participants: Claudia Detraux, Dominique Scapin [correspondant].

Title: PIMI
Type: ANR
Challenge: Personal Information Space
Instrument: Verso 2010
Duration: 2010 - 2013
Coordinator: Genigraph
Others partners: LRI, IRIT, Institut Telecom, Montimage, The Grand Duchy of Luxembourg

Abstract: PIMI Project aims at the definition of a design environment and a deployment platform for Personal Information Management system (PIM). The future PIM must provide the end-user personal data access with services that are relevant to his needs. In order to take mobility into account, the PIM will be accessed both by mobile devices (smartphone) and personal computers.

The main contribution this year is described in section 5.7.

This work also led to a PIMI project deliverable [70], in collaboration with LRI (P. Poizat). The research was pursued with another study [58] that produced ergonomic requirements for the PIMI prototype. An experiment with a mock-up simulating forms with their information content and providing the ability to change the structure and naming of items has been made. The observations concerned the users during the task of data entry and retrieval of data, and changes in the PIMI mockup. Also, the users acceptance to share their information or not has been recorded. The results led to a ranked list of recommendations on aspects including: structure and organization of content, items naming, information sharing, removal of sections and categories, redundancies.
6.2.6. Other Activities

6.2.6.1. Health

AxIS contributed to the CGIET report [100]:

- B. Trousse as Inria researcher and co-animator of the ICT Usage lab

M. Pallot participated to the “Séminaire Living Lab pour la santé et l’autonomie”, organised by CGIET, Paris, 25 January 2011 and to the “Colloque TIC Santé 2011”, Paris, 9 Février 2011, Association FORMATICSanté, Session “Le développement de Living Labs ou expérimentation des TIC par des communautés d’acteurs sociaux - Intérêt et limites dans le domaine sanitaire et médico-social”. This year we have several contacts between ICT Usage Lab (B. Trousse), Autonom’Lab (Limousin) and CNR santé (P. Mallea) in order to identify topics of future collaborations.

6.2.6.2. Collaborations linked to our Contracts

- FIREBALL and Future Internet Landscape: Interviews conducted with the main Inria scientific leaders of FIRE projects [69].
- ELLIOT and INRIA i-lab (CLIME EPI, Numtech SME): we have done a qualitative Data Analysis of 80 questionaries related to the Air Expert application demonstrated in Futur en Seine (June 17-26) by CLIME EPI.
- ELLIOT and ATMOPACA related to their website and its improvement.
- MIDAS (Telecom Paris Tech and EDF R&D): we collaborated with Georges Hébrail (Telecom/EDF) via the MIDAS project and the BiLab laboratory with A. da Silva [51].

Academic Collaborations

- Université de Bretagne Occidentale: M. Csernel collaborated with M. LePouliquen [30].
- Ecole Centrale de Paris: Y. Lechevallier collaborated via STIC France-Tunisia with M-A. Aufaure in the context of graph mining and Social Network [45], [33], [32] and of e-tourism [48].
- LIRM: S. Bringay, M. Roche P. Poncelet [25]
- IRIT (Toulouse): D. Scapin and C. Detraux collaborated with M. Winckler [70].
- LRI (Orsay): D. Scapin collaborated with P. Poizat [70].
- University of Nice Sophia Antipolis: Professor J-P Zirotti (Socioly, LASMIC laboratory) related to the “Master Urban Studies” and F. Debos (I3M laboratory) related to a new Palabes Ecofamilies (2012).

6.3. European Initiatives

6.3.1. FP7 Projects

6.3.1.1. STREP ELLIOT (2010 - 2013)

Participants: Anne-Laure Negri, Mylène Leitzelman, Bernard Senach, Caroline Tiffon, Brigitte Trousse [correspondant].

Title: ELLIOT
Type: COOPERATION (ICT)
Challenge: Experential Living lab Platform for the Internet of Things
Instrument: Specific Targeted Research Project (STREP)

[Conseil Général de l’Industrie, de l’Energie et des Techniques]
Perception, Cognition, Interaction - Other Grants and Activities - Project-Team AXIS

Duration: September 2010 - February 2013
Coordinator: TXT Polylemia (Italy)
Others partners: University of Nottingham, University of Readings, BIBA, Hospital San Rafael, CENG, Fing, Vulog
See also: http://www.elliot-project.eu/

Abstract: The ELLIOT project (Experiential Living Labs for the Internet of Things) aims at developing an Internet Of Things (IOT) experiential platform where users/citizen are directly involved in co-creating, exploring and experimenting new ideas, concepts and technological artifacts related to IOT applications and services. Based on a three levels experiential model issued from previous European projects, the study will capitalize on existing practices of co-creation in IoT contexts. It will allow the exploration of the potential impact of IOT and of the Future Internet in the context of the Open User Centered Innovation paradigm followed in the Living Lab approach.

This year we mainly specified our Green Service use case and the first prototype of the ELLIOT platform: This platform calls for the purposes of the data analysis component our FocusLab server: for the prototype we have implemented three methods as web services: SCDS for summarizing data streams as a approximative sequential pattern, GEAR for computing the tendency of several data streams and a specific one for the Hospital san rafaelle use case. As specified in ELLIOT D4.2.1, five co-conception workshops (2 groups) were held in order to identify the ideas and positions of citizen and stakeholders interested in mobility and air quality & noise level with regards to internet of things and potential services.

- 2 co-conception workshops in collaboration with the Regional Internet Space (ERIC in French) called Le Hublot in Nice: November 28 and December 12
- 3 co-conception workshops in Sophia Antipolis with citizen and stakeholders interested in Air quality and Mobility: November 25, December 7 and 19 As part of ELLIOT exploration step, we performed a heuristic evaluation of the atmopaca.fr website. Recommendations were reported to Atmopaca and site modified accordingly.

During these workshops participants were as well asked to explore an Android mock-up visualizing air quality, pollen level, bus station, free “vélo bleu” bicycle and noise level. A mock-up called Nice Air (V1) was developed by L. Gramusset during her internship for supporting the innovation process (cf. section 5.4.7).

6.3.1.2. CSA FIREBALL (2010 - 2012)

Participants: Marc Pallot, Brigitte Trouse [correspondant], Caroline Tiffon, Bernard Senach.

Title: FIREBALL
Type: CAPACITIES (ICT)
Challenge: Future Internet Research and Experiments by adopting Living Labs Towards Smart Cities
Instrument: Coordination and Support Action (CSA)
Duration: May 2010 - April 2012
Coordinator: Luleå University of Technology (Sweden)
Others partners: AALTO (Finland), AENESCE (Italy), MCC (United Kingdom), SAIM (Netherlands), ESADE (Spain), ALFAMICRO (Portugal), ISA (Portugal), E-NOVA (Portugal ) HK (Finland), INRIA (France), DIMES (Finland), IBBT (Belgium), AUTH (Greece), OY (Finland), IMAGES & RESEAUX (France), BCN (Spain)
See also: http://www.fireball4smartcities.eu/

Abstract: FIREBALL (Future Internet Experimental Facility and Experimentally-driven Research By Adopting Living Labs - towards Smart Cities) is a coordination action which establishes a coordination mechanism through which a network of Smart Cities across Europe engages in long term collaboration for adopting User Driven Open Innovation to explore the opportunities of the Future Internet.

8FIREBALL: Future Internet Experimental Facility and Experimentally-driven Research
We mainly have collaborations with Prof. Dr Nicos Komninos (Faculty of Engineering, Aristotle University of Thessalonik, Greece) and Hans Schaffers (Expert at ESoCE Net, Director of Adventure research, Nederlands) related to several scientific publications [34], [39], [29], [41] and also the deliverable [71]. See sections 5.4.3 and 5.4.4.

6.3.1.3. IDEAS (2010 - 2012)

**Participants:** Nicolas Béchet, Marc Csernel [correspondant].

- **Title:** IDEAS
- **Type:** CAPACITIES (SSH)
- **Instrument:** Coordination and Support Action (CSA)
- **Duration:** January 2010 - June 2012
- **Coordinator:** Ecole française d’Extrême Orient (France)

Other partners: University of Turku Institute of Ethnology, Hungarian Academy of Sciences, British Academy, Asien-Afrika-Institut of the University of Hamburg, Istituto italiano per l’Africa e l’Oriente

See also: [http://www.ideasconsortium.eu/](http://www.ideasconsortium.eu/)

**Abstract:** IDEAS is the acronym of “Integrating & developing European Asian studies”. It joins the efforts of five institutions devoted to the field of Asian studies and INRIA to help them on the I.T point of view. The overall objective of IDEAS is to make progress in coordinating and bringing together academic research, researchers and policy-makers. IDEAS will make use of the expertise and resources of a recently created network, the European Consortium for Asian Field Study (ECAF), which comprises 44 research institutions from ten EU countries and nine Asian countries and Russia, which specialize in Asian studies, and a network of 22 field research centers run by ECAF members across Asia.

Inria is leader of the Work Package 3 which will facilitate the access of scholars and others involved with Asian Studies to the ECAF network’s knowledge resources and develop multidisciplinary web-based research tools. WP3 initially focuses on a sample base comprising manuscripts in Tibetan and Sanskrit kept in the Giuseppe Tucci collection at IsIAO 9 in Roma. INRIA, focusing on information retrieval and data management, has developed a prototype of a website dedicated to the consultation ancient Asian. We have proposed a new search engine based on clustering techniques which provides always a “reasonable” number of answers whatever the question, allowing by successive ameliorations to obtain the most suitable answers, even without knowing the right question. This prototype has been constructed by N. Béchet and demonstrated on a set of pictures (such as stupas..) displayed on the current IsIAO website showing quite well the profit that one can expect from such a search engine.

6.3.2. Collaborations in European Programs, except FP7

6.3.2.1. TwinTide

**Participant:** Dominique Scapin [correspondant].

- **Program:** COST IC0904
- **Project acronym:** TwinTide
- **Project title:** Towards the Integration of Transectorial IT Design and Evaluation
- **Duration:** 2010 - 2013
- **Coordinator:** Effie Lai-Chong Law - Swiss Federal Institute of Technology (ETH Zürich), Switzerland (CH) / University of Leicester, UK


**Abstract:** Towards the Integration of Transectorial IT De-sign and Evaluation is a usability and user experience research community running under the auspices of COST (http://www.cost.esf.org/). The main objective is to harmonize research and practice on design and evaluation methodologies for computing artifacts, across sectors and disciplines, bringing together researchers and D&E professionals.

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9IsIAO: Istituto italiano per l’Africa e l’Oriente
6.3.3. Contribution to the Preparation of the Next Framework Programme (FP8 – Horizon 2020)

Participants: Marc Pallot, Brigitte Trousse.

M. Pallot participated to the FIA Roadmap workshop in Brussels, 31 March 2011, as member of the FISA (Future Internet Support Actions) roadmapping working group on FIA Roadmap [40] and contributed to the FISA Roadmap presented in May 2011 at FIA Budapest. AxIS participated to a “Smart Cities and FIRE” workshop at FIA Budapest in May 2011 and contributed to the linkage among Living Labs community, Smart Cities network and Future Internet Assembly [39], as well as relevant projects such as FIRESTATION, SmartSantander, TEFIS, ELLIOT, Apollon and many others.

6.4. International Initiatives

6.4.1. Participation to Standards in Ergonomics

Participants: Dominique Scapin [correspondent].

Standardization in ergonomics is increasingly important due to the application of the European directives about the introduction of measures to encourage improvements in the safety and health of workers (e.g., 2006/42CE on security of machinery); as well as taking into consideration national and international legislation, including accessibility. Standardization in ergonomics covers many issues. The contributions from INRIA (D. L. Scapin) concern mainly software ergonomics, in the context of AFNOR X35A, X35E, as well as ISO and CEN mirror groups:

- National: AFNOR X35A (Ergonomie des Logiciels Interactifs) (expert); AFNOR X35E (Ergonomie des Logiciels Interactifs) (chair).
- European: CEN/TC 122/WG 5 (Software ergonomics and human-computer dialogs) (expert)
- International: ISO/TC 159/SC4/WG5 (Software ergonomics and human-computer dialogues) (expert)

ISO/TC 159/SC4/WG6 (Human-centred design processes for interactive systems) (expert and co-editor of ISO 9241-230); JWG ISO/TC 159/SC 4 and ISO/IEC JTC1 SC 7 (System and software product Quality Requirements and Evaluation (SQuaRE) - Common industry Format) (expert); ISO/TC 159/SC1/WG1 (Ergonomic principles) (expert).

6.4.2. Visits of International Scientists

6.4.2.1. Internships

Alessandra Silva Anyzewski (from Apr 2011 until Oct 2011)

Subject: Proposition et implémentation d’un algorithme d’extraction de patrons de requêtes à partir d’un graphe.

Institution: Instituto Tecnológico de Aeronáutica - Divisão de Cooperação - Pró-Reitoria de Extensão e Cooperação (Brazil)

Yi-Ling Kuo Yi-Ling

Subject: Web Graph Clustering for Person Name Disambiguation Problem

Institution: National Central University (Taiwan)

Rong Guan (from April 2011 until July 2011)

Subject: Multivariate analysis of interval-valued data

Institution: Beihang University, Beijing, (China)

Amine Louati (from March 2011 until September 2011)
Subject: Social Network Aggregation  
Institution: ENSI, Tunis, Tunisia  

Ehab Hassan (from April 2011 until September 2011)  
Subject: Distances d'édition pour les textes Sanskrits  
Université de Dauphine, France  

Yacine Slimani (October 2011)  
Subject: A community detection algorithm for Web Usage Mining Systems  
LRIA, Université Ferhat Abbas, Sétif, Algérie

6.4.3. Participation In International Programs

6.4.3.1. FACEPE, Brazil 2003-2013  
Participants: Yves Lechevallier, Marc Csernel.

We pursue our collaboration on clustering and Web usage mining and start a collaboration on social network data analysis with Carvalho from,

We pursue our collaboration with F.A.T. De Carvalho, Professor at Federal University of Pernambuco (Recife) and his team. inside the scientific project Clustering of Relational Data and Social Network Data Analysis accepted by FACEPE and INRIA (01/2010-12/2011).

Researchers and students are concerned by this project from AxIS and CIn-UFPE side, which aims at developing methods of clustering of relational data and social network data analysis tools:

- This project aims to develop new clustering methods and algorithms for usual or complex feature data as well as for relational data. These new methods [23] (cf. section 5.2.2) will apply simultaneously on several feature or relational data tables and they must be able to learn a relevance weight for each data table in each cluster.

- M. Csernel has presented a new approach in Contrained Symbolic Data Analysis [26] (cf. section 5.2.3). M. Csernel has visited the UFPE during November and two topics on divisive clustering and the introduction of histogram variables in Norm Symbolic Form for clustering purpose were discussed.

A scientific project "Combining Methods for the Classification of Multi-valued and Interval Data" (CM2ID) submitted by F. De Carvalho and A. Napoli has been accepted by FACEPE and INRIA. The project starts on january 2012 and ends on december 2013. This project concerns two EPIs AxIS and Orpailleur.

6.4.3.2. STIC, Tunisia 2008-2011  
Participant: Yves Lechevallier.

During the STIC program, in collaboration with M.-A. Aufaure (Ecole Centrale), Y. Lechevallier supervised 4 masters and 2 PhD thesis (Raadi Lab, ENSI Tunis) in this project. These masters and PhD thesis subjects are about Web mining (usage, content and structure, using different methods) and ontology construction from heterogeneous sources. Y. Lechevallier is involved in a new STIC program Exploration des réseaux sociaux pour les systèmes de recommandation between France-Tunisia.

In this STIC project, we welcomed from ENSI (Tunisia) at Rocquencourt A. Louati (April-August). A. Louati participated actively to the themes of our STIC with the co-supervision of H. Baazaoui Zghal, M.-A. Aufaure, H. Ben Ghezala and Y. Lechevallier. In [33] and [32] we describe the need to design and implement a tool for analysing social networks based on the aggregation graphs. After a state-of-the-art of social networks and their analysis, a tool graph based aggregation approach was tested and applied on ADEME data by M-A Aufaure from Ecole Centrale. See section 5.3.1.
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR CoGiRo project

Participants: David Daney, Jean-Pierre Merlet, Julien Alexandre dit Sandretto.

The project CoGiRo, "Control of Giant Robots", deals with parallel cable-driven robots with very large workspaces and possibly heavy to very heavy payloads. This project, which began in February 2010, is funded by the French National Research Agency (ANR - Agence Nationale de la Recherche). Despite a great application potential, very large parallel cable robots have rarely been studied and even more rarely build. The main goal of the project CoGiRo is to propose and validate innovative methodologies and means to control, calibrate and design parallel cable-driven robots with very large workspaces. A prototype of a large parallel cable robot will be built. This prototype will serve as a demonstrator and will enable the experimental validation of the results obtained during the project. The partners of the project are:

- LIRMM - DEXTER project team
- INRIA Sophia Antipolis - Méditerranée - COPRIN project team
- LASMEA - ROSACE
- Tecnalia France

8.1.2. ID4CS project

Participant: Yves Papegay.

The ID4CS project, supported by French National Research Agency (ANR) through COSINUS program has the ambition to propose a modeling and simulation environment for designing complex systems such as aircrafts, based on a self-adaptive, distributed and open multi-agent architecture distributing the optimization process inside the agents.

As a partner of the project we are mainly involved in the definition of the use case on preliminary aircraft design, in collaboration with Airbus (6.3.2), in development of uncertainty analysis algorithms, and in automatic generation of agents based on models.

8.1.3. ANR SIROPA project

Participants: David Daney, Jean-Pierre Merlet [correspondant], Yves Papegay.

The ANR funded SIROPA project\(^2\) whose objectives was a better understanding of the singularities of parallel robots has been concluded this year [24]. The partners of this project were:

- IRCCYN Nantes
- University Rennes 1
- Nantes University (LINA)
- project teams SALSA (INRIA Rocquencourt) and COPRIN

Several interesting results regarding singularities of less than 6 degree-of-freedom and wire-drive parallel robots were obtained and were validated experimentally. This project has been concluded by an October school attended by 15 European students.

\(^2\) [https://twiki-sop.inria.fr/twiki/bin/view/Projets/Coprin/SIROPA](https://twiki-sop.inria.fr/twiki/bin/view/Projets/Coprin/SIROPA)
8.1.4. Large scale initiative PAL

COPRIN has played an important role for the creation of the INRIA large scale initiative Personnal Assistant Living (PAL), devoted to the assistance to elderly and handicaped people. Our work in this field is described in the sections 6.1.5, 6.1.4, 6.1.2.

8.2. European Initiatives
 Participants: David Daney, Jean-Pierre Merlet, Yves Papegay.

Program: FP7-2011-NMP-ICT-FoF, Factory of the Future
Project acronym: CableBot
Project title: Parallel Cable Robotics for Improving Maintenance and Logistics of Large-Scale Products
Duration: December 2011 - December 2014
Coordinator: Tecnalia
Other partners: LIRMM (France), FRAUNHOFER-IPA (Germany), Duisburg-Essen University (Germany), EADS (France), ACCIONA (Spain), VICINAY (Spain)

Abstract: The CableBOT project deals with a novel methodology for designing, developing and evaluating cable robots customized for the automation in large-scale auxiliary processes. Parallel cable robots extend the payloads and workspace of conventional industrial robots by more than two orders of magnitude. The main objective is to develop a new generation of modular and reconfigurable robots able to perform many different steps in the post-production of large-scale structures.
DAHU Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

Dahu is currently participating in one ANR project:

**ENUM** is a research project supported by the ANR blanche (2007-2011) on algorithmic and complexity problems raised by enumerating solutions of a query. The goal is to provide formal methods to understand and compare the complexity of enumerations problems. The partners are University of Paris-7 (with Arnaud Durand), the project-team Mostrare at INRIA-Lille (with Joachim Niehren), the university of Caen (with Etienne Grandjean) and the university of Marseille (with Nadia Creignou). Dahu is involved in the ANR as part of the Paris-7 node. For more information please visit the web pages of ENUM: [https://gforge.inria.fr/plugins/wiki/index.php?EnumerationProject&id=267&type=g](https://gforge.inria.fr/plugins/wiki/index.php?EnumerationProject&id=267&type=g).

Dahu is also the coordinator of one ARC INRIA

**ACCESS** is an ARC INRIA on Access Control for Web data, a two years project starting in 2010. The goal of this project is to study security and access control techniques for Web data exchange, and in particular the problems of the verification of access control policies (ACP) for XML and of the enforcement of ACP for secure query evaluation and update propagation. As a case study, the results are applied to an XML-based collaborative editing system. The partners are the teams CASSIS and PAREO at the INRIA center of Nancy-Grand-Est, and the team MOSTRARE at the the INRIA center of Lille-Nord-Europe. For more information please visit the web pages: [http://acxml.gforge.inria.fr](http://acxml.gforge.inria.fr).

6.2. European Initiatives

6.2.1. FP7 Projects

6.2.1.1. FOX

Title: FOX
Type: COOPERATION (ICT)
Defi: FET Open
Instrument: Specific Targeted Research Project (STREP)
Duration: May 2009 - April 2012
Coordinator: Luc Segoufin, INRIA (France)
Others partners: Thomas Schwentick at the university of Dortmund, Mikołaj Bojańczyk at the university of Warsaw, Leonid Libkin at the university of Edinburgh, Georg Gottlob at the university of Oxford, Frank Neven at the university of Hasselt and Maarten Marx at the university of Amsterdam.
See also: [http://fox7.eu](http://fox7.eu)
Abstract: The objective of FoX is to study the fundamental issues necessary in order to make the data management over the internet more efficient and more reliable.

6.2.1.2. Webdam

Title: WebDam
Type: IDEAS
Instrument: ERC Advanced Grant (Advanced)
Duration: December 2008 - November 2013
Coordinator: Serge Abiteboul, INRIA (France)
Others partners: Ioana Manulescu, Leo, INRIA and Pierre Senellart, Telecom Paristech.
See also: http://webdam.inria.fr

Abstract: The goal is to develop a formal model for Web data management. This model will open new horizons for the development of the Web in a well-principled way, enhancing its functionality, performance, and reliability. Specifically, the goal is to develop a universally accepted formal framework for describing complex and flexible interacting Web applications featuring notably data exchange, sharing, integration, querying and updating. We also propose to develop formal foundations that will enable peers to concurrently reason about global data management activities, cooperate in solving specific tasks and support services with desired quality of service.

### 6.2.2. Major European Organizations with which Dahu has followed Collaborations

Partner 1: University of Franckfurt, Nicole Schweikardt (Germany)
Subject 1: Logic and complexity.

### 6.3. International Initiatives

#### 6.3.1. INRIA International Partners

Victor Vianu, UC San Diego, USA.

#### 6.3.2. Visits of International Scientists

##### 6.3.2.1. Senior scientists on sabbatical

Victor Vianu (from Jan 2011 until September 2011)
- Subject: AXML
- Institution: UC San Diego (USA)

Howard Straubing (from May 15 until June 15)
- Subject: Tree automata
- Institution: Boston College (USA)

##### 6.3.2.2. Internship

Facundo CARREIRO (from March 2011 until Jul 2011)
- Subject: Arithmetical and Language-based Constraints on Finite Ordered Trees
- Institution: Universidad de Buenos Aires (Argentina)

### 6.3.3. Participation In International Programs

Dahu is coordinator (on the French side) of the project INRIA-DGRSRT (Tunisian universities) 10/I01 on the verification of security properties of Web services, access control policies and firewalls for XML. This project started in 2010, the other partners are the CASSIS team at INRIA Nancy-Grand-Est and the Security team at Sup’Com Tunis.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. CLIMASTER: Changement climatique, systèmes agricoles, ressources naturelles et développement territorial

Participant: Marie-Odile Cordier.

We are involved in a PSDR GO (research program "Pour et Sur le Développement Régional Grand Ouest") project, named CLIMASTER that started in 2009 and will end in November 2011. The goal of the project is to investigate and characterize climate change in the west of France as well as determining the trends, the extrema and the variability with respect to spatial location. For detailed information about the project, consult http://www.irisa.fr/dream/PDF/PSDRGO_CLIMASTER-2012.pdf or the CLIMASTER website: http://www.rennes.inra.fr/climaster/.

8.2. National Initiatives

8.2.1. SACADEAU-APPEAU: Decision-aid to improve streamwater quality

Participants: Marie-Odile Cordier, Véronique Masson, Christine Largouët.

The SACADEAU project (Système d’Acquisition de Connaissances pour l’Aide à la Décision pour la qualité de l’EAU - Knowledge Acquisition System for Decision-Aid to Improve Streamwater Quality) was funded by INRA (French institute for agronomy research) from October 2002 to October 2005. The main partners were from INRA (SAS from Rennes and BIA from Toulouse) and from IRISA. We have continued to develop the SACADEAU model with our partners until now and a PhD thesis has been funded by INRA (ASC).

We were then involved in a project, named APPEAU and funded by ANR/ADD, which started in February 2007 and ended in December 2010. The APPEAU project aimed at studying which politics, for which agronomic systems, are best adapted to improve water management. It included our previous partners as well as new ones, mainly from INRA. A paper has been written in 2011 in cooperation with all the partners and submitted to Environmental Modelling and Software, currently in revision.

Our work aims at building a decision-aid tool to help specialists in charge of the catchment management to preserve the streamwater quality. The SACADEAU simulation model couples two qualitative models, a transfer model describing the pesticide transfer through the catchment and a management model describing the farmer decisions. The simulation results are analyzed, thanks to classification and symbolic learning techniques, in order to discover rules explaining the pesticide concentration in the stream by the climate, the farmer strategy, the catchment topology, etc., and, finally, in order to build recommendation actions for a given situation. In the APPEAU context, the idea is to study how this kind of model can be used to simulate scenarios in a more generic way and to compare, and possibly unify, our work with what is done by our partners from SAS concerning nitrate transfer. (http://wwwagir.toulouse.inra.fr/agir/index.php?option=com_content&view=article&id=62&Itemid=134)

8.2.2. ACASSYA: Supporting the agro ecological evolution of breeding systems in coastal watersheds

Participants: Marie-Odile Cordier, Véronique Masson, René Quiniou, Christine Largouët.
The ACASSYA project (ACcompagner l’évolution Agro-écologique des SYstèmes d’élevage dans les bassins versants côtiers) is funded by ANR/ADD and started at the beginning of 2009. The main partners are our colleagues from INRA (SAS from Rennes. One of the objectives is to develop modeling tools supporting the management of ecosystems, and more precisely the agro ecological evolution of breeding systems in coastal watersheds. In this context, the challenge is to transform existing simulation tools (as SACADEAU or TNT2) into decision-aid tools, able to answer queries or scenarios about the future evolution of ecosystems. (http://www.rennes.inra.fr/umras/programmes/acassya_accompagner_l_evolution_agro_ecologique_des_systemes_d_elevage)

8.2.3. PayOTe-II: characterizing agricultural landscapes via data mining

Participants: Thomas Guyet, Christine Largouët, René Quiniou.

The PAYOTe-II project (Paysage Ou Territoire) is funded by AIP INRA/INRIA and started at the end of 2010. The project associates INRIA Teams (Orpailleur and Dream) with INRA Team (UBIA, MIAJ and SAD-Paysage).

One of the objectives of the PAYOTe project is to provide tools to generate “realistic” agricultural landscapes. This kind of generator is expected by expert to study the impact of the landscape on agro-ecological systems. The main approach of this project is to use data mining to automatically construct a neutral model of a landscape. Then, the model of a landscape may be used to generate new landscapes with same spatial properties.

In this context, the challenge is to develop spatio-temporal data mining algorithms to analyse the spatial organization of agricultural landscapes.

8.2.4. PAYTAL: Mining spatial correlations between urban sprawl and landscape

Participant: Thomas Guyet.

The PAYTAL project (Paysage et Etalement Urbain - Landscape and urban sprawl) is funded for 3 years by the French Ministry of Ecology and Sustainable Developement. This project started in september 2011. It involves our colleagues from INRA/SAS and Agrocampus-Ouest.

This project proposes a multidisciplinary approach, firstly, to describe the fine forms of urban sprawl and the dynamics of the landscape and, secondly, to study the links between urban sprawl and landscape evolution. The first aim of the project is to develop a methodology to acquire a spatial description of both the landscape and the urban extent. This spatial information will be acquired by our colleagues from remote sensing images and available official documents (local development plans, landscape repository, etc.) related to several “conurbations” in western France (Rennes, Angers, Lorient, Brest).

Our work aims at using and proposing spatio-temporal data mining tools to extract landscape patterns, i.e. a set of landscape elements linked through spatial relationships. Using symbolic learning techniques, we expect to extract landscape spatial patterns that may explain the urban sprawl (evolution barrier or facilitator).
E-MOTION Project-Team (section vide)
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. AVISICIL: open project, PACA Region

AVISICIL is a 3-years project funded by the PACA Region which complements the ANR project ISICIL. AVISICIL goal (as repositioned in 2010) is to contribute to the design of a system supporting elderly people by recognizing/monitoring their emotions through various sensors. The AVISICIL partners are: the Edelweiss research team; the Kewi research team (I3S Laboratory, UNS, France), and the Laboratoire de Psychologie Cognitive et Sociale (UNS, France). This year, we conducted a social ergonomic study to provide elements of design and evaluation of a system aimed at recognizing the affective states that indicate a loss or maintenance of social ties of elderly people (see section 6.2.5.2).

8.2. National Initiatives

8.2.1. DBpedia.fr

Participants: Julien Cojan, Fabien Gandon.

This project named DBpedia.fr proposes the creation of a french version of the DBpedia base used in many applications in english, in particular for the publication of cultural collections. Unfortunately, DBpedia is focused on the english version of Wikipedia and ignores some of the french topics and their data. This project aims at extracting a maximum of RDF data from the french version of Wikipedia and providing a stable and scalable end-point for them. This project is funded by the Ministry of Culture.

8.2.2. Kolflow

Kolflow is an ANR project (2011-2014), it proposes to extend collective intelligence with smart agents relying on automated reasoning. Smart agents can significantly reduce the overhead of communities in the process of continuously building knowledge. Consequently, continuous knowledge building is much more efficient. Kolflow aims at building a social semantic space where humans collaborate with smart agents in order to produce knowledge understandable by humans and machines.

Partners: INRIA Orpailleur & Edelweiss, Silex U. Claude Bernard Lyon, GDD U. of Nantes


8.2.3. DataLift

DataLift is an ANR project (2010-2013). Its goal is to design a platform to publish and interlink datasets on the Web of data. DataLift will both publish datasets coming from a network of partners and data providers and propose a set of tools for easing the datasets publication process. DataLift brings raw structured data coming from various formats (relational databases, CSV, XML, …) to semantic data interlinked on the Web of Data.

Partners: INRIA Exmo & Edelweiss, LIRMM, Eurecom, Mondeca, Atos, IGN, INSEE, FING

Web site: http://wwwdatalift.org

8.2.4. ISICIL

ISICIL is an ANR project (2009-2012), it proposes to study and to experiment with the usage of new tools to assist corporate intelligence tasks. These tools rely on web 2.0 advanced interfaces (blog, wiki, social bookmarking) for interactions and on semantic web technologies for interoperability and information processing.
8.3. International Initiatives

8.3.1. Participation In International Programs

8.3.1.1. AUF

The Edelweiss team is partner of an AUF project with University Gaston Berger, Saint-Louis, Senegal. The topic of the project is: Social Semantic Web Platform for Knowledge Sharing in West Africa Communities.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. BQR Intuactive (2011-2014)

Participants: Rémi Brouet, Marie-Paule Cani, Jean-Claude Léon.

The Intuactive project is a collaboration between our research group, the conception group of G-scop lab, and the HCI group of LIG lab. The goal is to develop and compare 2D vs 3D interaction for selecting, placing and editing 3D shapes. The project is funded by Grenoble-INP and provides the grant for Rémi Brouet’s PhD.

8.1.2. BQR INP IDEAL (04/2009 - 03/2012)

Participants: Dobrina Boltcheva, Jean-Claude Léon.

3D models, coming for instance from engineering fields, are often ‘idealized’, or ‘simplified’ (topologically speaking), in order to be used for simulation. The goal of this project IDEAL, funded by Grenoble-INP, is to study these models, in particular the most general ones which are called ‘non-manifolds’ and which are not handled by current software. We collaborate in this project with the University of Genova in Italy (Leila De Florian).

8.1.3. BQR INP "Modèles multirésolutions de fissures" (04/2009 - 09/2012)

Participants: Marie Durand, François Faure.

A project on the simulation of fracture propagation in concrete structures has started, funded by INP Grenoble. The purpose is to develop a mixed, dynamic model of structures, using finite elements everywhere except near crack fronts, where a discrete model is applied. This goes beyond the ANR Vulcain project (section 8.2.1) because we want to dynamically switch between finite element and discrete models. Bui Huu Phoc has started a Ph.D. in October, co-tutored by Frederic Dufour and Vincent Richefeu, from the L3S-R CNRS laboratory, and François Faure from EVASION.

8.1.4. LIMA "Loisirs et Images" (2007 - 2011)

Participants: Marie-Paule Cani, François Faure, Damien Rohmer.

LIMA (Loisirs et Images) was a Rhône-Alpes project in the ISLE cluster (Informatique, Signal, Logiciel Embarqué) focused on classification and computer graphics. This project founded the PhD for Lucian Stanculescu with Raphaëlle Chaine (LIRIS) and Marie-Paule Cani. It lead to the generation of a new free form sculpture tool [11]. A research seminar in July had been organised to end the project in July. It gathers scientist from computer graphics and computer vision, and Bob Sumner presented the recent work from Disney Research Zurich to the community. An other project from the ISLE cluster will start in the future on a similar topic in order to pursue gathering scientists from Rhône-Alpes region and continue on the promising results of LIMA.

8.1.5. Scenoptique

Participant: Rémi Ronfard.
In October 2011, we started a collaboration with Theatre des Celestins in Lyon on the topic of interactive editing of rehearsals. This research program is funded by the Region Rhone Alpes as part of their CIBLE project, with a budget for a doctoral thesis (Vineet Gandhi) and three large sensor video cameras. Theatre des Celestins is interested in novel tools for capturing, editing and browsing video recordings of their rehearsals, with applications in reviewing and simulating staging decisions. We are interested in building such tools as a direct application and test of our computational model of film editing, and also for building the world’s first publicly available video resource on the creative process of theatre rehearsal. Using state-of-the-art video analysis methods, this corpus is expected to be useful in our future work on procedural animation of virtual actors and narrative design. The corpus is also expected to be shared with the LEAR team as a test bed for video-based action recognition.

8.2. National Initiatives

8.2.1. ANR Vulcain (06/2008-06/2011)

Participants: Marie Durand, François Faure.

We participate to the ANR Vulcain project (http://vulcain.ujf-grenoble.fr/), which purpose is to evaluate the vulnerability of buildings such as industrial facilities undergoing explosions of projectile impacts. Marie Durand has implemented discrete element models in GPU in order to speed up concrete fracturing simulations, and an article has been submitted to the European Journal of Environmental and Civil Engineering.

8.2.2. ANR RepDyn (01/2010-12/2012)

Participants: Marie Durand, François Faure.

We participate to the ANR RepDyn project, started at the beginning of 2010, in collaboration with CEA, EDF, Laboratoire de Mécanique des Structures Industrielles Durables (LaMSID), and ONERA. The purpose of this project is to enhance the performance of discrete elements and fluid computations, for the simulation of cracks in nuclear reactors or planes. Our task is to propose GPU implementations of particle models, as well as load balancing strategies in the context of multi-core, multi-GPU hardware. Marie Durand is doing a PhD thesis on this task.

8.2.3. ANR ROMMA (01/2010-12/2013)

Participants: François Faure, Stefanie Hahmann.

The ANR project ROMMA has been accepted in 2009 and started in January 2010. The partners of this project are academic and industry experts in mechanical engineering, numerical simulation, geometric modeling and computer graphics. There are three academic members in the consortium: the LMT in Cachan, G-SCOP and LJK (EVASION and MGMI teams) in Grenoble. There are four industrial members: EADS, which coordinates the project, SAMTECH, DISTENE and ANTECIM. The aim of the project is to efficiently and robustly model very complex mechanical assemblies. We are working on the interactive computation of contacts between mechanical parts using GPU techniques. We will also investigate the Visualization of data with uncertainty, applied in the context of the project.

8.2.4. ANR SOHUSIM (01/2010-12/2013)

Participants: Ali Hamadi Dicko, François Faure.

Sohusim (Soft Human Simulation) is done in collaboration between: EVASION (INRIA), Fatronik France (TECNALIA), DEMAR (INRIA), HPC PROJECT and the CHU de Montpellier.

This project deals with the problem of modeling and simulation of soft interactions between humans and objects. At the moment, there is no software capable of modeling the physical behavior of human soft tissues (muscles, fat, skin) in mechanical interaction with the environment. The existing software such as LifeMod or OpenSim, models muscles as links of variable length and applying a force to an articulated stiff skeleton. The management of soft tissues is not taken into account and does not constitute the main objective of this software.
A first axis of this project aims at the simple modeling and simulation of a passive human manipulated by a mechatronics device with the objective of studying and designing patient manipulation with very low mobility (a clinic bed). The second axis concentrates on the detailed modeling and simulation of the interaction of an active lower limb with objects such as orthesis, exoskeleton, clothes, or shoes. The objective is to provide a tool for designing devices in permanent contact with the human, which allows determining the adequate ergonomics in terms of form, location, and materials, according to the intended use.

Dicko Ali Hamadi is a Ph.D. student at the EVASION team. His work focuses on the problems in the SOHUSIM project. He is co-tutored by Olivier Palombi in EVASION and Benjamin Gilles in DEMAR.

8.2.5. PlantScan3D (ARC INRIA 09/2009-09/2011)

Participants: Dobrina Boltcheva, Marie-Paule Cani, Cédric Zanni.

This project is in collaboration with Virtual Plants and Galaad teams. Its objective is to develop the use of a laser scanner for plant geometry reconstruction, in partnership with biologists-agronomists from several teams in France and Europe. Our last contributions include the development of new representations for the plant enabling the use of the skeleton and thickness information computed by the other teams from scanner data.

8.3. European & International Initiatives

8.3.1. PASSPORT (06/2008-05/2011)

Participants: Guillaume Bousquet, François Faure.

The PASSPORT for Liver Surgery project (http://www.passport-liver.eu/Homepage.html) deals with the objectives of the Virtual Physiological Human ICT-2007.5.3 objective. PASSPORT’s aim is to develop patient-specific models of the liver, which integrates anatomical, functional, mechanical, appearance, and biological modeling. These static models, PASSPORT will add dynamics liver deformation modeling and deformation due to breathing, and regeneration modeling providing patient-specific minimal safety standardized FLR. These models, integrated in the Open Source framework SOFA, will culminate in generating the first multi-level and dynamic virtual patient-specific liver allowing not only to accurately predict feasibility, results, and the success rate of a surgical intervention, but also to improve surgeons’ training via a fully realistic simulator, thus directly impacting upon definitive patient recovery suffering from liver diseases.

The final review was held in December in Strasbourg. Our deliverables were delivered on time.

8.3.2. IRIS Network of Excellence (2009-2011)

Participant: Rémi Ronfard.

The IRIS (Integrating Research in Interactive Storytelling) Network of Excellence (NoE) started its work in January 2009, as a new EC-funded initiative (under FP7’s Intelligent Content and Semantics). The IRIS network includes work packages on Narrative Formalisms; Artificial Intelligence Tools and Techniques; Authoring Tools and Creation Methods; Hybrid Intelligent Virtual Actors; Cinematography; Interaction and Dialogue. As part of the work package on cinematography, we proposed a computational framework for film editing suitable for interactive storytelling applications. The model has been implemented in collaboration with the Bunraku/Mimetic team and demonstrated to IRIS project members.

8.3.3. SHARE INRIA Associate Teams (2009-2011)

Participants: Adrien Bernardt, Marie-Paule Cani, François Faure, Damien Rohmer.

SHARE is a joint associate with the INRIA project BIPOP, which funds collaborations with the University of Vancouver. It brings together researchers with complementary expertise in geometric modeling, computer graphics, mechanics, robotics, control, neuroscience and perception, and who aim to jointly tackle key elements of modeling and animation of humans and animals interacting with their environment. The project had three foci: 1) designing enriched geometric and mechanical models for the shape and motion of soft tissues, skin, cloth, and hair; 2) improving existing models of human and animal motion; and 3) modeling interaction between moving creatures and complex, realistic environments.
8.3.4. Visits of International Scientists

- Alla Scheffer visited EVASION team for 6 months.
EXMO Project-Team

8. Other Grants and Activities

8.1. National grants and collaborations

8.1.1. Datalift ANR contint platform

Participants: Zhengjie Fan, Jérôme David, Jérôme Euzenat [Contact].

Exmo coordinates with LIRMM the Datalift project whose goal is to produce a platform for publishing governmental data as linked data. Exmo is particularly involved in the generation of links between datasets [22] [19].

More information on Datalift can be found at http://www.datalift.org.

8.1.2. DataRing ANR Verso Project

Participants: Manuel Atencia [Contact], Jérôme Euzenat.

Exmo participates, as part of the LIG partner, in the DataRing project about peer-to-peer data sharing for online communities. We work more directly with Marie-Christine Rousset on trust in semantic peer-to-peer networks.

More information on DataRing can be found at http://www.lina.univ-nantes.fr/projets/DataRing/.

8.2. European initiatives

8.2.1. SEALS infrastructure project: Evaluating semantic technologies

Participants: Cássia Trojahn dos Santos [Contact], Jérôme Euzenat.

Exmo is a partner of the SEALS European commission infrastructure project whose goal is to provide the infrastructure for evaluating semantic technologies. Jérôme Euzenat is vice-coordinator in charge of the research area.

More particularly, Exmo is in charge of providing an infrastructure for evaluating ontology matching systems and algorithms, to be aggregated in the SEALS platform. This task involves:

- designing evaluation campaigns, including identifying criteria, metrics, datasets, and tools to be used in each campaign,
- designing and implementing services for automatic evaluation of systems and algorithms,
- analysing the results of evaluation campaigns and using them to produce a detailed report on both the effectiveness of the testing methodologies, and the systems that have been tested.

This year we have prepared the second SEALS evaluation campaign and designed a fully automated evaluation process [20] [23] [24]. We have also organised the OAEI 2011 campaign (§6.1.1) [9].

More information on SEALS can be found at http://www.seals-project.eu/.

8.3. International Initiatives

8.3.1. Collaborative and Automatic Methods for the Multilingualisation of Lexica and Ontologies (Cameleon)

Participants: Cássia Trojahn dos Santos [Contact], Jérôme Euzenat.

The Cameleon project is a 4 years joint CAPES-COFECUB project. It aims at creating, reinforcing and continuing academic exchanges between French and Brazilian researchers in the domain of multilingual lexica and ontologies. Exmo’s main tasks is to contribute to multilingual matching and interfacing ontologies and lexica.

More information on Cameleon can be found at http://cameleon.imag.fr/.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. CRA ARAUI

A Conseil Régional d’Aquitaine Project (ARAUI, 2011-) began, coordinated by Manuel Lopes entitled \textit{Apprentissage Automatique en Robotique pour l’Adaptation aux Utilisateurs a Travers L’Interaction}. It will fund 50\% of a 3 years PhD student and funding of 5500 euros for equipment. The objective of ARAUI is the creation of robots that initiate autonomously the execution of frequent tasks after learning about the user’s preferences through repeated interactions. Particularly these robots will act as personal companions or helpers and will be able to perform shared tasks with humans.

The long-term view of this project is that of a robot that comes out of the box with general purpose motor and sensory skills and then is adapted to each user’s preferences and needs to achieve autonomous behavior. The major challenge is how to equip machines with such adaptability and learning capabilities. Until now machines are programmed by skilled engineers to perform a specific task and learning new tasks is not possible. Even in a restricted industrial setting the need for robots that can be more easily re-programmed to new tasks and environments has lead to research programs on flexible manufacturing that consider frequent changes in tasks and close (physical) interactions with human operators.

8.1.2. CRA DEVROB

The Conseil Régional d’Aquitaine Project (DEVROB, 2008-) continued, involving Pierre Rouanet and Pierre-Yves Oudeyer. The funding contributes with 50\% funding for a 3 years PhD student. The objective of DEVROB is to study, elaborate and experiment human-robot interfaces that allow a non-engineer human to teach intuitively and robustly new visually grounded words to a robot.

8.1.3. CRA ACROBATE

The Conseil Régional d’Aquitaine Project (ACROBATE, 2009-) continued, involving Thomas Cederborg and Pierre-Yves Oudeyer. The funding contributes with 50\% funding for a 3 years PhD student. The objective of ACROBATE is to study mechanisms and models that can allow a robot to learn in a unified manner context-dependant motor skills and linguistic skills through interactions with humans.

8.1.4. ADT Acrodev

The ADT project (Acrodev, 2010-) continued, involving Paul Fudal, Haylee Fogg, Olivier Ly and Pierre-Yves Oudeyer. The INRIA ADT funds two engineers for two years. The objective of Acrodev is on the one hand to build up re-usable software architectures for embedded control of Acroban-like robots, and on the other hand to explore novel morphologies in particular for the feet, hands and head of Acroban-like robots.

8.1.5. Collaboration with Institut de Neurosciences Cognitives et Integratives d’Aquitaine

A collaboration began with Jean-René Cazalets, Christophe Halgand and Etienne Guillaud from Institut de Neurosciences Cognitives et Integratives d’Aquitaine, Bordeaux. The goal is to compare properties of the postural balance, and its relation to morphology and distributed control, in humans and in the humanoid Acroban, which vertebral column and postural control shares several fundamental features with the human vertebral column, and using the “Plateforme d’analyse de la motricité” available at the Institut de Neurosciences Cognitives et Integratives d’Aquitaine. This collaboration involves Matthieu Lapeyre, Olivier Ly and Pierre-Yves Oudeyer.
8.2. National Initiatives

8.2.1. ANR MACSi

An ANR Project (MACSi, ANR Blanc 0216 02), coordinated by ISIR/Univesity Paris VI (Olivier Sigaud), on developmental robotics (motor learning, visual learning, and exploration algorithms on the ICub robot) continued. The MACSi project is a developmental robotics project based on the iCub humanoid robot and the Urbi open source software platform. It is funded an as ANR Blanc project from 2010 to 2012. The project addresses four fundamental challenges, led by four partners:

- How can a robot learn efficient perceptual representations of its body and of external objects given initially only low-level perceptual capabilities? Challenge leader: INRIA-ENSTA-ParisTech FLOWERS (Paris).
- How can a robot learn motor representations and use them to build basic affordant reaching and manipulation skills? Challenge leader: ISIR-UPMC-Paris 6 (Paris). ISIR hosts the iCub humanoid robot on which the achievements will be evaluated.
- What guidance heuristics should be used to explore vast sensorimotor spaces in unknown changing bodies and environments? Challenge leader: INRIA-ENSTA-ParisTech FLOWERS (Bordeaux).
- How can mechanisms for building efficient representations/abstractions, mechanisms for learning manipulation skills, and guidance mechanisms be integrated in the same experimental robotic architecture and reused for different robots? Challenge leader: GOSTAI company (Paris).

Web site: http://macsi.isir.upmc.fr/

8.3. European Initiatives

8.3.1. Collaborations in European Programs, ERC

Program: ERC Starting Grant
Project acronym: EXPLORERS
Project title: Exploring Epigenetic Robotics: Raising Intelligence in Machines
Duration: 12/2009-11/2014
Coordinator: Pierre-Yves Oudeyer

Abstract: In spite of considerable and impressive work in artificial intelligence, machine learning, and pattern recognition in the past 50 years, we have no machine capable of adapting to the physical and social environment with the flexibility, robustness and versatility of a 6-months old human child. Instead of trying to simulate directly the adult’s intelligence, EXPLORERS proposes to focus on the developmental processes that give rise to intelligence in infants by re-implementing them in machines. Framed in the developmental/epigenetic robotics research agenda, and grounded in research in human developmental psychology, its main target is to build robotic machines capable of autonomously learning and re-using a variety of skills and know-how that were not specified at design time, and with initially limited knowledge of the body and of the environment in which it will operate. This implies several fundamental issues: How can a robot discover its body and its relationships with the physical and social environment? How can it learn new skills without the intervention of an engineer? What internal motivations shall guide its exploration of vast spaces of skills? Can it learn through natural social interactions with humans? How to represent the learnt skills and how can they be re-used? EXPLORERS attacks directly those questions by proposing a series of scientific and technological advances: 1) we will formalize and implement sophisticated systems of intrinsic motivation, responsible of organized spontaneous exploration in humans, for the regulation of the growth of complexity of learning situations; 2) intrinsic motivation systems will be used to drive the learning of forward/anticipative sensorimotor models in high-dimensional multimodal spaces, as well as the building of reusable behavioural macros; 3) intrinsically motivated
exploration will be coupled with social guidance from non-engineer humans; 4) an information-theoretic framework will complement intrinsically motivated exploration to allow for the inference of body maps; 5) we will show how learnt basic sensorimotor skills can be re-used to learn the meaning of early concrete words, pushing forward human-robot mutual understanding. Furthermore, we will setup large scale experiments, in order to show how these advances can allow a high-dimensional multimodal robot to learn collections of skills continuously in a weeks-to-months time scale. This project not only addresses fundamental scientific questions, but also relates to important societal issues: personal home robots are bound to become part of everyday life in the 21st century, in particular as helpful social companions in an aging society. EXPLORERS’ objectives converge to the challenges implied by this vision: robots will have to be able to adapt and learn new skills in the unknown homes of users who are not engineers. The ERC EXPLORERS is a central scientific driver of the FLOWERS team.

8.4. Exterior research visitors

Marc Toussaint from Free University of Berlin, jointly with Tobias Lang, visited INRIA as Professeur Invités, see details of the collaboration below.

8.5. International Initiatives

8.5.1. INRIA International Partners

- Luis Montesano, University of Zaragoza, Spain. Manuel Lopes collaborated with Luis Montesano on active learning approaches for grasping point learning. Results were published in Robotics and Autonomous Systems [16].
- Francisco Melo Instituto Superior Técnico, Portugal. Manuel Lopes collaborated with Francisco Melo on the development of active learning for inverse reinforcement learning. Recent developments consider the extension to more cues available to the learner and sampling complexity on the algorithm.
- José Santos-Victor, Instituto Superior Técnico, Portugal. Manuel Lopes collaborated with José Santos-Victor on the extension of affordances models to higher levels of representations, e.g. relational models.
- Maya Cakmak, Andrea Thomaz, Georgia Tech, USA. Manuel Lopes collaborated with Maya Cakmak on the development of optimal teaching algorithms for sequential decision problems (modeled as markov decision processes). The algorithm provides optimal demonstrations for systems that learn using inverse reinforcement learning. The joint work considers not only the algorithmic aspects but also a comparison with human behavior and the possibility of using insights from the algorithm to elicit better teaching behavior on humans [41].
- Marc Toussaint, Tobias Lang, Free University of Berlin, Germany. Manuel Lopes and Pierre-Yves Oudeyer are collaborating with FUB in the unification of exploration algorithms based on intrinsic motivation with methods for exploration in reinforcement learning such as $R_{max}$. We intend to develop a general framework for exploration in non-stationary domains. Another project consider how to learn efficient representation for robotic hierarchical planning.
- Jacqueline Gottlieb, Columbia University, New-York, US. Adrien Baranes, Pierre-Yves Oudeyer and Manuel Lopes began a collaboration with Jacqueline Gottlieb, neuroscientist at Columbia University and specialist of visual attention and exploration in monkeys. An experimental set-up with brain imaging and behavioural observations of monkeys, and made to evaluate new families of computational models of visual attention and exploration (some of which developed in the team around the concept of intrinsic motivation) is being elaborated. Adrien Baranes will go in postdoc at Jacqueline Gottlieb’s laboratory through a FulBright grant, and experiments shall begin next year.
- Louis ten Bosch, Radboud University, The Netherlands. Pierre-Yves Oudeyer and David Filliat continued to work with Louis ten Bosch on the modelling of multimodal language acquisition using techniques based on Non-Negative Matrix Factorization. We showed that these techniques can allow a robot to discover audio-video invariants starting from a continuous unlabelled and unsegmented flow of low-level auditory and visual stimuli. A journal article is in preparation.

- Paul Vogt (Tillburg University, The Netherlands), Linda Smith (Indiana University, Bloomington, US), Aslo Ozyurek (Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands), Tony Belpaeme (University of Plymouth, UK). Pierre-Yves Oudeyer began collaboration with partners of the NWO SCMSC project to set up a research network on modeling of social cognition and symbolic communication.

- Michael Gienger from Honda Research Institute Europe. Alexander Gepperth collaborated with Principal Scientist Dr. Michael Gienger from Honda Research Institute Europe GmbH about robotic grasping: this activity will result in a jointly supervised internship (“stage de fin d’études”) and a publication.

- Ursula Korner from Honda Research Institute Europe. Alexander Gepperth collaborated with Senior Scientist Ursula Korner from Honda Research Institute Europe GmbH on the topic of “Biologically motivated models of robotic memory acquisition and consolidation using the PROPRE algorithm”. This activity has resulted in the submission of a conference publication to the European Symposium on Neural Networks (ESANN) 2012 and will result in additional journal publications as well as the creation of a robotic demonstration system.

- Michael Garcia Ortiz, Laboratory for Cognitive Robotics (CoR-Lab) in Bielefeld, Germany. Alexander Gepperth collaborated with Michael Garcia Ortiz, a PhD student from the Laboratory for Cognitive Robotics (CoR-Lab) in Bielefeld, Germany, on the exploitation of scene context for object detection in intelligent vehicles. This collaboration resulted in the submission of a journal publication to the journal "Neurocomputing".

- Martha White, Patrick Pilarski, Joseph Modayil, Adam White, and Richard Sutton, University of Alberta, Canada. Thomas Degris is collaborating with Martha White, Patrick Pilarski, Joseph Modayil, Adam White, and Richard Sutton from the Reinforcement Learning and Artificial Intelligence group at the University of Alberta on new learning algorithms for robots. One paper is in the process of being published, two others are in progress. Moreover, via the University of Alberta, Thomas Degris uses for his research a cluster belonging to the Alberta Ingenuity Centre for Machine Learning, and a cluster from Westgrid (http://www-westgrid.ca/), a member of the High Performance Computing consortia in Canada.

- Stefan Schaal, University of Southern California (Los Angeles, USA). Freek Stulp is continuing his collaborative work with Prof. Stefan Schaal of the University of Southern California (Los Angeles, USA), and founding director of the Max-Planck-Institute for Intelligent Systems (Tübingen, Germany). This project aims at combining algorithms from evolutionary optimization and direct reinforcement learning to achieve adaptive exploration for life-long learning in a developmental robotics context. We intend to submit this work to the International Conference on Intelligent Robots and Systems as well as the International Conference on Development and Learning.

8.5.2. Visits of International Scientists

- Marc Toussaint, Technical University Berlin, Germany (November 2011)
- Tobias Lang, Technical University Berlin, Germany (November 2011)
- Luis Montesano, University of Zaragoza, Spain (November 2011)
- Yukie Nagai, Osaka University, Japan (March 2011)
- Jan Peters, TU Darmstadt, Germany (September 2011)
- Robert Damper, University of Southampton, UK (May 2011)
8.5.3. Participation In International Programs

8.5.3.1. NWO project: Socio-Cognitive Mechanisms of Symbolic Communication

SCMSC is a project funded by NWO (Netherlands Organization for Scientific Research) on Socio-Cognitive Mechanisms of Symbolic Communication, and coordinated by Paul Vogt (Tillburg University). This project aims to study the socio-cognitive mechanisms of symbolic communication. In contrast to other species, humans have the capacity to communicate symbolically (i.e. using forms that are either arbitrary or conventionised) in an open fashion (i.e. with a very large repertoire of symbols). It is widely accepted that our ability to communicate symbolically has both cognitive and social roots. In recent years, traditional approaches from humanities to study symbolic communication, such as linguistics and psychology, have been complemented by computational approaches. However, interactions between researchers from the humanities with computer modellers have been few and far between, perhaps due to a lack of mutual understanding of what each field can contribute to the other.

In this project, we will set up a structural research network to improve cross fertilization between researchers from different disciplines by exchanging knowledge and experiences, and join forces to study communication multidisciplinary. This way, we aim to improve each other’s research methods and investigate unifying properties of the socio-cognitive mechanisms underlying symbolic communication. To achieve this, we propose to start up an open structural research network in which we will organise two workshops, apply for joint research funding, set up an online repository of publications, educational and other materials, and publish an edited collection.

Partners are Paul Vogt (Tillburg University, The Netherlands), Linda Smith (Indiana University, Bloomington, US), Pierre-Yves Oudeyer (INRIA-ENSTA-ParisTech, France), Aslo Ozyurek (Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands), Tony Belpaeme (University of Plymouth, UK). Web site: http://ilk.uvt.nl/~paul/scmsc/SCMSC/Home.html.
GRAPHIK Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

We are taking part in the Laboratory of Excellence ("labex") NUMEV (Digital and Hardware Solutions, Modelling for the Environment and Life Sciences), led by University of Montpellier 2 in partnership with CNRS, University of Montpellier 1 and INRIA. This project aims at developing information and communication technologies for environmental and life sciences. We are participating to one of the four axes, namely "Scientific Data: processing, integration and security".

8.2. European Initiatives

8.2.1. EcoBioCap

FP7-KBEE, March 2011–March 2015. Led by INRA (and scientifically managed by Montpellier IATE laboratory). Sixteen partners among which Cork University (Ireland), CSIC (Spain), Roma University La Sapienza (Italy), SIK (Sweden). The objective of EcoBioCAP is to “provide the EU food industry with customizable, ecoefficient, biodegradable packaging solutions with direct benefits both for the environment and EU consumers in terms of food quality and safety”. GraphIK is involved in this project via its common members with IATE-KRR team. The budget is managed by IATE team. This project will feed Axis 2.

8.3. International Initiatives

Invited research visit in Japan (June-August 2011): Michaël Thomazo has been invited to Ken Kaneiwa laboratory at Iwate University (Japan), thanks to a grant from the Japan Society for the Promotion of Science (JSPS). A comparison between the existential rule framework studied in GraphIK and the predicate/meta-predicate hierarchies framework as studied by Ken Kaneiwa in [59] has been conducted. They have been shown mutually reducible to each other, allowing to enrich existential rules with meta-predicates and to discover new decidable classes for query answering with (meta-)predicate hierarchies. Article in preparation.

8.3.1. Visits of International Scientists

- Meghyn Bienvenu, CNRS INRIA LEO (1 week in May 2011) - Collaboration on query answering on knowledge bases;
- Nir Oren, Univ. of Aberdeen (1 week in May 2011) - Collaboration on argumentation for multi-agent systems;
- Sebastian Rudolph, Univ. of Karlsruhe, "Knowledge Management Group" (5 weeks in March / April 2011) - Collaboration on existential rules;
- Leon van Torre, Univ. of Luxembourg (1 week in October 2011) - Collaboration on dynamic argumentation systems;
- Serena Villata, Univ. of Torino, January 2011 - Contact on argumentation systems.
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Co-Drive

Instrument: FUI-10
Duration: 2009-2012
Coordinator: Valeo

Abstract: the objective is to design and develop a user-end on-the-shelf product. This product will be embarked on a vehicle and is supposed to guide the driver and/or perform autonomous actions in order to optimize the driving process for enhanced mobility and security.

8.1.2. Corebots

Instrument: ANR
Duration: 2009-2012
Coordinator: Armines

Others partners: Intempora, Epitech
See also: http://corebots.net/

Abstract: The CoreBots team has been constituted to participate in the CAROTTE challenge for advanced autonomous robots organized by the French DGA and ANR. It is made of public and private entities specialized in robotics and gathers specialists of robotics hardware, software architecture and algorithms.

8.1.3. ABV

Title: Automatisation basse vitesse
Instrument: ANR
Duration: 2009-2012
Coordinator: IFFSTAR

Others partners: Continental, IBISC, IEF, Induct, LAMIH, Vismetris, UHA-MIPS, Véolia Environnement
See also: http://www.projet-abv.fr/

Abstract: This ambitious project aims at demonstrating automated driving at low speed in urban areas and on peri-urban roads...

8.1.4. PUMAS

Title: Plate-forme Urbaine de Mobilité Avancée et Soutenable
Instrument: FUI
Duration: 2010-2012
Coordinator: Egis Mobilité

Others partners: Induct, Intempora, Armines, Insa-Rouen, Esigelec
See also: http://www.projet-pumas.fr/
Abstract: The purpose of the project PUMAS is to create a platform for travel time information for cities and towns.

8.1.5. AMARE

Title: Accrochage Mécanique Automatique à Rendez-vous Électronique
Instrument: ADEME
Duration: 2009-2011
Coordinator: Modulowatt
Others partners: Valeo, Aicom, ADM Concept, Aixam Mega, DBT, Eigsi, groupe Chastagner
See also: http://www.modulowatt.com/Modulowatt_Projets.html
Abstract: AMARE is an innovative aiming at developing an original system dedicated to the automated charging of electric vehicles.

8.1.6. Travesti

Title: Traffic Volume Estimation via Space-Time Inference
Instrument: ANR SYSCOMM
Duration: 2009-2012
Coordinator: Inria (TAO)
Others partners: Armines
See also: http://travesti.gforge.inria.fr
Abstract: This project addresses the problem of modelling large scale complex systems to provide predictions of their macroscopic behaviour. For application purpose, we focus here on the particular problem of the real-time prediction of traffic conditions on a road network.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. HAVE-IT

Title: Highly Automated Vehicles for Intelligent Transport
Type: COOPERATION (ICT)
Defi: Intelligent vehicles and mobility services
Instrument: Integrated Project (IP)
Duration: February 2008 – July 2011
Coordinator: Siemens AG, Siemens VDO Automotive (Germany)
Others partners: DLR (D), VW (D), IFSTTAR (F), ICCS (GR), EPFL (CH), USTUTT (D), VTEC (S), EFKON (A), KB (H), Ibeo (D), SVF (F), UAM (D), BME (H) ...
See also: http://www.haveit-eu.org
Abstract: HAVE-IT aims at the realization of the long-term vision of highly automated driving for intelligent transport. The project will develop, validate and demonstrate important intermediate steps towards highly automated driving. The results offer a high potential for exploitation within 3-7 years after HAVE-IT. In the longer term they also form the ideal basis to integrate further next generation ADAS and drivetrain components that offer highly automated functionalities.

8.2.1.2. INTERSAFE 2
Title: Cooperative Intersection Safety
Type: COOPERATION (ICT)
Defi: ICT for cooperative Systems
Instrument: Specific Targeted Research Project (STREP)
Duration: June 2008 – May 2011
Coordinator: Ibeo Automobile Sensor GmbH (Germany)
Others partners: BMW F+T (D), IKA (D), NEC (UK), SBH (D), TRW (UK), UTCLUJ (R), VTEC (S), VIT (FL), VW (D), Ibeao (D)
See also: http://www.intersafe-2.eu
Abstract: The INTERSAFE-2 project aims to develop and demonstrate a Cooperative Intersection Safety System (CISS) that is able to significantly reduce injury and fatal accidents at intersections. The novel CISS combines warning and intervention functions demonstrated on three vehicles: two passenger cars and one heavy goods vehicle. Furthermore, a simulator is used for additional R&D. These functions are based on novel cooperative scenario interpretation and risk assessment algorithms.

8.2.1.3. ITSSv6
Title: ITSSv6 : IPv6 ITS Station Stack for Cooperative Systems FOTs
Type: COOPERATION (ICT)
Defi: IPv6 ITS Station Stack for Cooperative Systems FOTs
Instrument: Specific Targeted Research Project (STREP)
Duration: February 2011 – January 2014
Coordinator: INRIA (France)
See also: http://cordis.europa.eu/fetch?CALLER=PROJ_ICT_TEMP&ACTION=D&CAT=PROJ&RCN=98319 (temporary link)
Abstract: ITSSv6 aims at developing a reference open-source IPv6 ITS Station stack available to European and national third parties (projects, industry and academia) using IPv6 for Internet-based communications in Field Operational Tests (FOTs) of Cooperative Systems. The IPv6 networking capabilities of the ITS Station under standardization at ISO TC204 WG16 (CALM) and ETSI TC ITS are extended with additional IPv6 features required for operational deployment of Cooperative Systems i.e. enhanced performance, embedded security, remote management of deployed systems and ease of configuration. New features and their perfect integration within the ITS Station architecture (particularly ITS Station management and ITS Facilities) are specified. The project takes as an input the FP6 CVIS core communication software and additional modules developed by FP7 GeoNet. It produces an enhanced IPv6 ITS Station stack adapted to operational use in large scale FOTs to the benefit of a variety of Cooperative Systems applications which require Internet communications (road safety, traffic efficiency and infotainment types of applications).

8.2.1.4. DRIVE C2X
Title: DRIVE C2X – Accelerate cooperative mobility
Type: COOPERATION (ICT)
Defi: Driving implementation of car 2 x communication technology
Instrument: Integrated Project (IP)
Duration: March 2011 – February 2014
Coordinator: DAIMLER AG (Germany)
See also: http://www.drive-c2x.eu/project
8.2.1.5. CityNetMobil

Title: CityNetMobil
Type: CAPACITIES (TRANSPORTS)
Instrument: Coordination and Support Action (CSA)
Duration: August 2008 – July 2011
Coordinator: Centro for Transport and Logistic (CTL) – Roma (Italy)
Others partners: GEA Partners (CH), POLIS (B)
See also: http://citynetmobil.org

Abstract: Will our cities become more and more congested, polluted, and unsafe, or is there a way to reverse this trend? One new idea for urban transport is small automated low-polluting vehicles for driverless transport in cities. But can such novel systems solve mobility problems in any city? Can they be integrated into the urban structure and conventional transport networks? How would users react?

CityNetMobil is a three-year EC FP7 support action with the specific objective of helping cities answer these questions. The project began on 1 September 2008 and will run until 1 September 2011.

The project invites all interested cities to join a group of cities sharing an interest in advanced transport systems.

8.2.1.6. CityMobil

Title: Towards Advanced Road Transport For the Urban Environment
Type: IP
Instrument: COOPERATION
Duration: May 2007 – December 2011
Coordinator: TNO-Eindhoven (Netherlands)
Others partners: DLR (D), DITS (I), CRF (I), ULTra (UK), ITS Leeds (UK), EPFL (CH),...(35 partners)
See also: http://www.citymobil-project.eu

Abstract: Citymobil is a major research, development and demonstration project. it addresses the integration of automated transport systems in the urban environment. Integration based on real-life implementations of the automated transport system of 3 sites is the focus. There is a total budget of > 40 million euro.

8.2.1.7. PICAV

Title: Personal Intelligent City Accessible Vehicle System
Type: COOPERATION (TRANSPORTS)
Instrument: Specific Targeted Research Project (STREP)
Duration: August 2009 – July 2012
Coordinator: Univ. of Genoa (Italy)
Others partners: UCL (UK), UNIPI (I), MAZEL (E), ZTS VVU (SK), TCB (P)
See also: http://www.dimec.unige.it/PMAR/picav/
Abstract: PICA V is a new mobility concept for passengers ensuring accessibility for all in urban pedestrian environments. It is also a new transport system that integrates a fleet of PICA V units. Some of its features are specifically designed for people whose mobility is restricted for different reasons the main drivers of PICA V design are: ergonomics, comfort, stability, small size, mobility dexterity on-board intelligence, assisted driving, eco-sustainability, parking, vehicle/infrastructures intelligent networking. PICA V system usefully integrates the existing public transport system to make it become more accessible for older and disabled people by acting as a smooth link between walking, bicycle and conventional public transport.

8.2.1.8. CATS

Title: City Alternative Transport System
Type: COOPERATION (TRANSPORTS)
Instrument: Specific Targeted Research Project (STREP)
Duration: January 2010 – December 2013
Coordinator: Lohr Industrie (France)
Others partners: CTL (I), EPFL (CH), TECHNION (IL), GEA (CH), ERT (F), and the cities of Formello (I), Strasbourg (F), Ploiesti (R)
See also: http://www.cats-project.org

Abstract: CATS’ aim is the full development and experimentation of a new urban transport service based on a new generation of vehicle. Its major innovation is the utilisation of a single type of vehicle for two different uses: individual use or semi collective transport. This new transport service is aimed at filling the gap between public mass transport and private individual vehicles.

8.2.1.9. SANDRA

Title: Seamless Aeronautical Networking through the integration of Data links Radios and Antennas
Type: COOPERATION (TRANSPORTS)
Instrument: Integrated Project (IP)
Duration: October 2009 – September 2013
Coordinator: Selex Communications (Italy)
Others partners: ___PARTNERS???___ Organisme, labo (pays) See also: http://www.sandra.aero/

Abstract: The SANDRA concept consists of the integration of complex and disparate communication media into a lean and coherent architecture that provides and manages seamless service coverage across all airspace domains and all aircraft classes. The SANDRA validation activity will show the ability of the proposed integrated architecture to easily reconfigure and adapt for the flexible implementation of new communication services.

8.2.2. Major European Organizations with which Imara has followed Collaborations

University of Murcia (Spain)
After a first contact established at the Mobile IST Summit in summer 2007 with Antonio F. Gómez Skarmeta, a PhD student from University of Murcia (José Santa Lozano) was hosted by IMARA for 3 months. He studied our communication architectures and realized some performance evaluation of our communication system using our in-vehicle testbed. The evaluation tools developed during this work will be used again to evaluate forthcoming results on geographic networking.

University Carlos III of Madrid (Spain)
a new collaboration started between IMARA and the Robotics Lab of the University of Carlos III especially with the visiting Professor Jorge Villagrá. Since his research interests include nonlinear and optimal control for automotive applications, nonlinear estimation, and robust networked control systems in robotic applications, IMARA started a collaboration with him in these fields. A first result of this cooperation was the hosting by IMARA of a PhD student from this university: Joshue Perez Rastelli spent 3 months at IMARA. He studied our activities in control-command for mobile vehicles and contributed in the AMARE project. In March 2012, he will integrate IMARA in a Post-doctoral position.

University of Roma La Sapienza (Italy)

IMARA and the Centre of Transport and Logistics of the University of Rome La Sapienza have been close partners in several European projects (Cybercars, CityMobil, CityNetMobil...). We have shared interests in cybercars and in the design of new transportation models and systems in general. Early 2011, Professor Adriano Alessandri spent 3 months at INRIA in our team. His stay was the opportunity to organize a number of events and showcases and to prepare a common proposal for a new European project that was submitted late 2011. This collaboration seem to be very fruitful for both parties from the scientific point of view. We believe this relationship will be a permanent relationship between these institutions.

Technical University of Sophia (Bulgaria)

IMARA is conducting a close partnership with the Technical University of Sophia (Department of Mechanical Engineering). Since 2009, Professor Plamen Petrov has been a visiting professor at INRIA. He contributed in conducting common advanced researches with IMARA researchers in the field of dynamic modeling and adaptive motion control for vehicles and robots. Joint works have been also driven to develop and validate platooning concepts for normal speed driving of automated vehicles. This collaboration will continue with further scientific challenges to tackle especially in the field of vehicle control and motion planning.

We also maintain longstanding bilateral relations with the following centers:

- Imperial College (E. Gelenbe);
- University of Oxford (J. Martin);
- The Institute of Communications and Computer Systems (ICCS) of the National Technical University (NTU) of Athens, Greece.

8.3. International Initiatives

8.3.1. INRIA International Partners

We are cooperating with a number of labs worldwide without contract commitment.

SwRI: in 2007, INRIA signed a collaboration agreement with the Southwest Research Institute (San Antonio, Texas, USA) for the joint development of autonomous vehicle technologies, focusing on the areas of perception, intelligence, command and control, communications, platforms and safety. SwRI is one of the oldest and largest nonprofit applied research and development organizations in the U.S. The partnership will conduct joint research and exchange intellectual property to foster rapid technology and system advancements in vehicle autonomy. In 2011, This collaboration agreement has been reconducted for four more years.

Keio University (Japan): IMARA has established links with Jun Murai Lab at Keio University in Japan since 2005, which led Thierry Ernst to join IMARA in 2006. Since then, we are working with Keio University and other labs in Japan and in France grouped into the Nautilus6 project which is working on IPv6 mobility enhanced mechanisms allowing continuous access to the Internet while on the move. From this cooperation, we were able to hire a PhD student who completed his MSc at Keio University. In addition, three labs from Keio
University with different backgrounds (automatic vehicles, electric vehicles and Internet communications) have joined forces into the so-called co-Mobility project aiming at developing the vehicle of the future. The intersection between Keio University’s activities on this project and IMARA is a tremendous set of common research topics and as such we have been invited to a Co-Mobility workshop in Japan in January.

University of Tokyo (Japan): During his 1-year stay within IMARA Dr. Yoshio Mita’s (associate professor at Tokyo University) was successful into organizing a private workshop between University of Tokyo and IMARA. It was held in July and gathered 10 researchers from Japan. From this workshop a number of new collaboration items were identified, including on the communication research topic in which there was not previous cooperation with University of Tokyo. In 2009 and 2011, INRIA and the University of Tokyo organized two bi-national workshops at INRIA. In 2011, this workshop was held on January 6th at INRIA Rocquencourt with the participation of 25 people from both laboratories. We are likely to enforce our cooperation with University of Tokyo in the coming years.

NICTA (Australia): After first contacts established in 2007, a PhD student started his work on a joint PhD program between NICTA and IMARA. This student is currently working in Australia. Our commitment on this joint PhD supervision guarantees an outstanding cooperation with NICTA. In addition to the ongoing joint PhD supervision, IMARA has welcomed an intern from NICTA who worked on security applied to ITS architecture communications.

ESPRIT (École Supérieure PRivée d’Informatique et de Technologie, Tunis, Tunisia): IMARA is welcoming interns from this private school for the past 2 years and hired them as engineers. A joint seminar, involving IMARA, HIPERCOM, ESPRIT and ENSI took place in February 2010. A wider cooperation has been decided, based on the common interest in vehicular adhoc networking and more particularly geonetworking (geographic addressing and routing). ESPRIT and IMARA started in February 2010 the development of an open-source implementation of IPv6 GeoNetworking conforming with the specification of the FP7 GeoNet project now adopted by ETSI TC ITS. This code will be published as open-source early 2011.

NAIST (Nara Institute of Sciences and Technologies – Nara – Japan): IMARA and NAIST are extending their cooperation on ITS communication architecture based on the work realised by a PhD student from NAIST who is spending more than half his PhD course at IMARA. An AYAME proposal has been submitted but this funding program has been aborted due to lack of funding on the Japanese side (JSPS). However, NAIST has secured an internal funding allowing to send interns in 2011.

We also maintain longstanding bilateral relations with the following centers:

- University of Moscow (V. Malyshev);
- University of Saint-Petersburg (R. Iasnogorodski);
- IPPI, Dobrushin’s Laboratory, Academy of sciences, Moscow (A. Rybko);
- several teams in USA (Berkeley, Columbia, Monterey, AT&T);
- The Electronics and Telecommunications Research Institute, Korea;

8.3.2. Visits of International Scientists

- Professor Adriano Alessandrini (University of Rome La Sapienza, CTL Lab) visited IMARA from February to April 2011
- Professor Plamen Petrov (Technical University of Sofia, Mechanical department) visited IMARA from July to September 2011
- Dr. Joshue Perez Rastelli (University of Carlos III, Robotics Lab) visited IMARA from September to November 2011

8.3.3. Participation In International Programs

French-Asian cooperation: in the context of the Asian-French project CityHome, very close collaboration were driven between INRIA’s IMARA and E-Motion project-teams and Asian laboratories such as: NTU (Singapore), Dept. of Computer Science and Electrical Engineering Graduate School of Science and Technology
Kumamoto University (Japan), Department of Automation of the Shanghai Jiao Tong University (SJTU University, China) and the Information and Communication Engineering and the Intelligent Systems Research Center at the SungKyunKwan University (SKKU), (Korea). A new similar project has started (PAMM) announcing new visits between the partners and new collaboration around autonomous vehicles and intelligent systems.
7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. Pl@ntNet project [2009-2013]

It is a joint project with AMAP (CIRAD, INRA, IRD, Montpellier) and Tela Botanica, an international botanical network with 8,500 members and an active collaborative web platform (10,000 visits /day). The project has its financial support from Agropolis International Foundation (http://www.agropolis.fr/) and is titled “Plant Computational Identification and Collaborative Information System”.

7.1.2. Other collaborations with INRA

The PhD thesis of Wajih Ouertani, financed by INRA, in the context of a strategic collaboration between INRIA and INRA, addresses interactive species identification through advanced relevance feedback mechanisms based on local image information.

7.1.3. ANR project SCAR-FACE [2008-2011]

SCAR-FACE (Semantic Characterization And Retrieval of FACEs) objective is to develop new interactive technologies for recognizing people in public places provided with videosurveillance networks. Other partners: Univ Caen - INRIA LEAR, EADS, SPIKENET, IREENAT

IMEDIA activities within the project started with the arrival of Sébastien Poullot (see section 6.4.1 ).

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. CHORUS+

Title: CHORUS+ Network of Audio-Visual Media Search
Type: CAPACITIES (ICT)
Defi: Networked Medias & 3D Internet
Instrument: Coordination and Support Action (CSA)
Duration: January 2010 - December 2012
Coordinator: JCP-Consult (France)
Others partners: UNITN (Italy), HES-so (Switzerland), Thomson R&D (France), JCPC (France), CERTH (Greece), TU Wien (Austria), ENG (Italy), IPTS (Belgium)
See also: http://www.ist-chorus.org/
Abstract: CHORUS + has been funded in the continuity of the former CHORUS initiative thanks to its success. Beyond CHORUS coordination objectives, CHORUS+ includes new key issues such as extended cooperation and coordination to Asian countries and US, support to integration and implementation, support to coordinated research evaluations or support to results dissemination of EU projects. Nozha Boujema and Alexis Joly are part of the management board of the project.

7.2.1.2. GLOCAL

Title: Glocal (Event-Based Retrieval of Networked Media)
Type: COOPERATION (ICT)
Defi: Networked Medias & 3D Internet
Instrument: Integrated Project (IP)
Duration: December 2009 - November 2012
Coordinator: Univ. Degli Studi di Trento (Italy)
Others partners: UNITN (Italy), ISOCO (Spain), ALINARI (Italy), CERTH (Greece), Yahoo Iberia SL (Spain), AFP (France), DFKI (Germany), Exalead (France), LUH (Germany), BUT (Czech Republic)
See also: http://www.glocal-project.eu/
Abstract: The key idea underlying the project is to use events as the primary means for organizing and indexing media. Within networked communities, common (global) descriptions of the world can be built and continuously enriched by a continuous flow of individual (local) descriptions. With two leading search companies and four content providers, the consortium attempts to realize and evaluate this approach in several application domains, which will involve professional and amateur users dealing with professional and generic contents. IMEDIA is responsible of three research tasks related to visual-based event indexing, retrieval and mining, notably in distributed contexts.

7.2.1.3. I-SEARCH
Title: I-SEARCH (A unified framework for multimodal content SEARCH)
Type: COOPERATION (ICT)
Defi: Networked Medias & 3D Internet
Instrument: Specific Targeted Research Project (STREP)
Duration: January 2010 - December 2012
Coordinator: CENTRE FOR RESEARCH AND TECHNOLOGY HELLAS (Greece)
Others partners: CERTH (Greece), JCPC (France), ATTC (Greece), ENG (Italy), Google (Germany), UNIGE (Italy), Exalead (France), FHE (Germany), ANSC (Italy), EGR (Germany)
See also: http://www.isearch-project.eu/isearch/
Abstract: The I-SEARCH project aims to provide a novel unified framework for multimodal content indexing, sharing, search and retrieval. The I-SEARCH framework will be able to handle specific types of multimedia and multimodal content (text, 2D image, sketch, video, 3D objects and audio) alongside with real world information, which can be used as queries and retrieve any available relevant content of any of the aforementioned types. IMEDIA is workpackage leader of “RUCOD COMPLIANT Descriptor Extraction”.

7.3. International Initiatives

7.3.1. Visits of International Scientists
Don Geman from John Hopkins University.

7.3.1.1. Internship
Olfa MZOGHI (from March 2011 until August 2012)
Subject: Analyse et description de la morphologie foliaire: Application à la classification et l’identification d’espèces de plantes
Institution: Université de Tunis El Manar - Faculté des Sciences (Tunisia)
7. Partnerships and Cooperations

7.1. Regional Initiatives

+ **WILD - Wall-sized Interaction with Large Datasets (2008-2011).** 3 academic partners: LRI, INRIA and LIMSI-CNRS. Funded by RTRA Digiteo and Région Île-de-France, Domaine d’Intérêt Majeur “Logiciels et systèmes complexes”: 429 Keuros. Emmanuel Pietriga & Michel Beaudouin-Lafon: coordinators and principal investigators. WILD is an experimental high-resolution, interactive platform for conducting research on collaborative human-computer interaction and the visualization of large datasets. The platform is now being made available to scientists from other disciplines, including astrophysicists, biologists, chemists, as well as computer scientists, to visualize, explore and analyze their data.

+ **WILD-PCRI (2010-2011).** Extension of the WILD project (same partners) to extend the WILD platform with multi-channel audio capabilities and a flat-panel multitouch surface, and move it to the new PCRI building.

+ **Design and evaluation of novel paper-based interfaces for large interactive surfaces (2010-2011).** 24 Keuros. Funded by Univ. Paris-Sud (“Bonus attractivité”). Theophanis Tsandilas: principal investigator. This equipment grant will allow us to explore the use of paper-based interfaces by scientists in the context of the multi-surface interaction paradigm that we develop for the WILD platform.

7.2. National Initiatives

+ **Digiscope - Collaborative Interaction with Complex Data and Computation (2011-2020) - http://digiscope.fr.** “Equipment of Excellence” project funded by the “Invesissements d’Avenir” program of the French government. 10 academic partners: FCS Paris-Saclay (coordinator), Université Paris-Sud, CNRS, CEA, INRIA, Institut Telecom ParisTech, Ecole Centrale Paris, Université Versailles - Saint-Quentin, ENS Cachan, Maison de la Simulation. Overall budget: 22.5 Meuros, including 6.7 Meuros public funding from ANR. Michel Beaudouin-Lafon: coordinator and principal investigator for the whole project. The goal of the project is to create nine high-end interactive rooms interconnected by high-speed networks and audio-video facilities to study remote collaboration across interactive visualization environments. The equipment will be open to outside users and targets four main application areas: scientific discovery, product lifetime management, decision support for crisis management, and education and training. In Situ will contribute the existing WILD room, a second room called WILDER funded by the project, and its expertise in the design and evaluation of advanced interaction techniques and the development of distributed software architectures for interactive systems.

+ **MDGest - Interacting with Multi-Dimensional Gestures (2011-2014).** In Situ is the only academic partner. Funded by the French National Research Agency (ANR), Programme JCJC (Junior researchers): 88 Keuros. Caroline Appert (coordinator) and Theophanis Tsandilas. This project investigates new interactions for small devices equipped with a touchscreen. Complementing the standard point-and-click interaction paradigm, the MDGest project explores an alternative way of interacting with a user interface: tracing gestures with the finger. According to previous work, this form of interaction has several benefits, as it is faster and more natural for certain contexts of use. The originality of the approach lies in considering new gesture characteristics (dimensions) to avoid complex shapes that can be hard for users to memorize and activate. Dimensions of interest include drawing speed (local or global), movement direction, device orientation or inclination, and distinctive drawing patterns in a movement.
HolyRisk - Scientific Uncertainty and Food Risk Regulation (2009-2013). 5 academic partners. Funded by the French National Research Agency (ANR), Programme BLANC: 61 Keuros/702 Keuros. Emmanuel Pietriga: principal investigator for In Situ. This project is conducting a US/EU comparative empirical study that investigates the ways uncertainties are perceived, handled and expressed by experts throughout the food risk analysis process. In Situ is contributing a visual interface that allows efficient multi-scale navigation in a large corpus of annotated documents.

MLSN - Multi-Level Social Networks (2009-2012). 4 academic and industrial partners. Funded by the French National Research Agency (ANR), Programme VERSO: 177 Keuros/738 Keuros. Emmanuel Pietriga: principal investigator for In Situ. Real-time social network visualisation of multiplex social interactions. MLSN is based on recent findings in academic research on graph drawing/navigation techniques and on network analysis.

7.3. International Initiatives

7.3.1. INRIA Associate Teams

- Equipe Associée Sirius (Principal Investigators: Michel Beaudouin-Lafon, Wendy Mackay): Joint lab between In Situ, the HCI Group at Stanford University and the Distributed Cognition and HCI Lab at University of California, San Diego. Wendy Mackay and Michel Beaudouin-Lafon are spending a sabbatical year, that began in September 2010, at Stanford University, with visits to UC San Diego. SIRIUS will continue this collaboration when they are back in France.

7.3.2. INRIA International Partners

- ALMA (Atacama Large Millimeter/submillimeter Array, http://www.almaobservatory.org/) (Principal Investigator: Emmanuel Pietriga): Collaboration over 4 years with the European Southern Observatory (ESO), the National Astronomical Observatory of Japan (NAOJ), and the National Radio Astronomy Observatory (NRAO)/NSF to redesign graphical user interfaces of the observatory’s operations monitoring and control software, based on state-of-the-art visualisation and interaction techniques. The project is partly be implemented using In Situ’s ZVTM toolkit (see Section 5.2).
IPARLA Project-Team (section vide)
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. FUI Rev-TV project

Participants: Guillaume Caron, Manikandan Bakthavatchalam, Céline Teulière, François Chapeau, Eric Marchand.

no. Inria 4549, duration: 36 months.

This project started in January 2010. It is composed of a consortium managed by Technicolor with Artefacto, Istia, Telecom Bretagne, Soniris, Bilboquet and Inria Lagadic and Metiss groups. The goal of this project is to provide tools to develop new TV programs allowing the final user to interact within an immersive and convivial interface. Within this project, we focus on the development of tracking algorithms (3D localization) and on visual servoing techniques for camera localization.

8.1.2. i-Lab ExtAR

Participants: Clément Samson, Eric Marchand.

duration: 24 months.

ExtAR is an Inria i-Lab with Artefacto that started in March 2011. Its goal is to develop an augmented reality library for smartphones.

8.2. National Initiatives

8.2.1. ANR Tosa CityVIP

Participants: Andrea Cherubini, Fabien Spindler, Eric Marchand, François Chaumette.

no. Inria 3208, duration: 42 months.

This project, managed by Lasmea, started in June 2008. It involves eight partners, including Lagadic. The project consists of enhancing the autonomy of urban vehicles by integrating sensor-based techniques with a geographical database. The work that we have realized within this project is described in Section 6.2.3.

8.2.2. ANR Contint Prosit

Participants: Tao Li, Alexandre Krupa, François Chaumette.

no. Inria 3585, duration: 46 months.

This project is led by the Prisme lab in Bourges. It started in December 2008 in collaboration with LIRMM in Montpellier, LMS in Poitiers, CHU of Tours, and the Robosoft company. Its goal is to develop an interactive master-slave robotic platform for medical diagnosis applications (tele-echography) with assistance functionalities. The work that we have realized within this project is described in Section 6.3.2.

8.2.3. ANR Contint US-Comp

Participants: Caroline Nadeau, Deukhee Lee, Alexandre Krupa, François Chaumette.

no. Inria 3560, duration: 42 months.

This project, led by Alexandre Krupa, started in December 2008. It involves a collaboration with the Visages team in Rennes, LSIIT in Strasbourg and LIRMM in Montpellier. Its goal is to provide methodological solutions for real-time compensation of soft tissues motion during ultrasound imaging. The approach consists in synchronizing the displacement of a 2D or 3D ultrasound probe to stabilize the observed image by the use of a robotic arm. The work that we have realized within this project is described in Sections 6.3.1 and 6.3.3.
8.2.4. **ANR P2N Nanorobust**

**Participant:** Eric Marchand.

**duration:** 48 months.

This project started in November 2011. It is composed of a consortium managed by Femto-ST with LPN, Isir, Thalès and Lagadic group through the Université de Rennes 1. Nanorobust deals with the development of micro- and nano-manipulation within SEM (Scanning Electron Microscope). Our goal is to provide visual servoing techniques for positioning and manipulation tasks with a nanometer precision.

8.2.5. **PEA Decsa**

**Participants:** Eric Marchand, François Chaumette.

**duration:** 36 months.

This project started in November 2011. It is composed of a consortium managed by Astrium with the Novadem, Sirehna, Spot Image and Magellium companies, and with the Inria Lagadic and Steep groups. It is devoted to the development of navigation and perception algorithms for small drones in urban environment.

8.3. **European Initiatives**

8.3.1. **FP7 Regpot Across**

Program: Regpot  
Project acronym: Across  
Project title: Center of Research Excellence for Advanced Cooperative Systems  
Duration: from September 2011 till March 2015  
Coordinator: Prof. Ivan Petrovic from University of Zagreb (Croatia)

Other partners: KTH (Sweden), ETHZ (Switzerland), TUM (Germany), University of Manchester (UK), Vienna University of Technology (Austria), Politecnico di Milano (Italy), University of Sevilla (Spain), Eindhoven University of Technology (The Netherlands), University of Athens (Greece), etc.

8.4. **International Initiatives**

8.4.1. **Visits of International Scientists**

Chuanto Zang, a Ph.D. student from Koichi Hashimoto’s lab at Tohoku University in Sendai, Japan, spent a two-month visit from January till March 2011.

8.4.2. **Participation In International Programs**

8.4.2.1. **STIC AmSud**

**Participants:** Eric Marchand, François Chaumette.

This project aims to handle the problem of monocular real-time 3D object tracking targeting augmented reality and visual servoing applications. This is a collaboration with the computer science center of Federal University of Pernambuco in Recife, Brazil and with the Robotics and automation division, Mining technology center at the Universidad de Chile in Santiago, Chile.

Joao Paulo Lima and Francisco Simoes from the Federal University of Pernambuco had a one-month visit in Rennes in November 2011. François Chaumette had a one-week visit at the Universidad de Chile in Santiago in December 2011.
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. QUAERO

Participants: Mohamed Ayari, Matthijs Douze, Dan Oneata, Danila Potapov, Alessandro Prest, Cordelia Schmid.

Quaero is a French-German search engine project supported by OSEO. It runs from 2008 to 2013 and includes many academic and industrial partners, such as INRIA, CNRS, the universities of Karlsruhe and Aachen as well as LTU, Exalead and INA. LEAR/INRIA is involved in the tasks of automatic image annotation, image clustering as well as large-scale image and video search. See http://www.quaero.org for more details.

8.1.2. Qcompere

Participants: Guillaume Fortier, Cordelia Schmid, Jakob Verbeek.

This three year project started in November 2010. It is aimed at identifying people in video using both audio (using speech and speaker recognition) and visual data in challenging footage such as news broadcasts, or movies. The partners of this project are the CNRS laboratories LIMSI and LIG, the university of Caen, INRIA’s LEAR team, as well as two industrial partners Yacast and Vecsys Research.

8.1.3. ANR Project GAIA

Participants: Cordelia Schmid, Jakob Verbeek.

GAIA is an ANR (Agence Nationale de la Recherche) “blanc” project that is running for 4 years starting October 2007. It aims at fostering the interaction between three major domains of computer science—computational geometry, machine learning and computer vision—, for example by studying information distortion measures. The partners are the INRIA project-teams GEOMETRICA and LEAR as well as the University of Antilles-Guyane and Ecole Polytechnique.

8.1.4. ANR Project SCARFACE

Participants: Frédéric Jurie [University of Caen], Cordelia Schmid, Gaurav Sharma.

Video surveillance systems are currently installed in many public areas. As their number increases, the manual analysis becomes impossible. The three-year project SCARFACE (2009-2011) develops tools to automatically access large volumes of video content in order to help investigators solve a crime. These tools will search videos based on human attributes, which describe the suspect. The participant of the project are: the university of Lille the INRIA Imagea team, SpikeNet, EADS, the University of Caen, and LEAR.

8.2. European Initiatives

8.2.1. FP7 European Project AXES

Participants: Ramazan Cinbis, Zaid Harchaoui, Dan Oneata, Danila Potapov, Cordelia Schmid, Jakob Verbeek.

This 4-year project started in January 2011. Its goal is to develop and evaluate tools to analyze and navigate large video archives, eg. from broadcasting services. The partners of the project are ERCIM, Univ. of Leuven, Univ. of Oxford, LEAR, Dublin City Univ., Fraunhofer Institute, Univ. of Twente, BBC, Netherlands Institute of Sound and Vision, Deutsche Welle, Technicolor, EADS, Univ. of Rotterdam. See http://www.axes-project.eu/ for more information.
8.2.2. FP7 European Network of Excellence PASCAL 2


PASCAL (Pattern Analysis, Statistical Modeling and Computational Learning) is a 7th framework EU Network of Excellence that started in March 2008 for five years. It has established a distributed institute that brings together researchers and students across Europe, and is now reaching out to countries all over the world. PASCAL is developing the expertise and scientific results that will help create new technologies such as intelligent interfaces and adaptive cognitive systems. To achieve this, it supports and encourages collaboration between experts in machine learning, statistics and optimization. It also promotes the use of machine learning in many relevant application domains such as machine vision.

8.3. International Initiatives

8.3.1. INRIA International Partners

- **NICTA**: In 2010 we initiated a collaboration with the Statistical Machine Learning group at NICTA, Canberra, Australia, i.e., Tiberio Caetano visited LEAR for 4 months. This year PhD student Thomas Mensink spent three months at NICTA, March ’11 – June ’11, and Jakob Verbeek spent 3 weeks at NICTA in May ’11. Results of the collaboration were presented in [16] at the NIPS ’11 workshop on Discrete Optimization in Machine Learning.

- **UC Berkeley**: Z. Harchaoui visited UC Berkeley twice in 2011, resp. in January and September 2011. This led to a research collaboration with N. El Karoui on the theoretical analysis of learning algorithms in high-dimensional settings and the influence of the marginal density of the examples on the generalization performance. This collaboration will continue in 2012.

- **ETH Zürich**: We collaborate with V. Ferrari, junior professor at ETH Zürich since his postdoctoral fellowship with the LEAR team in 2006. V. Ferrari and C. Schmid are currently co-supervising a PhD student (A. Prest) on the subject of automatic learning of objects in images and videos [7], [26]. A. Prest is bi-localized between ETH Zürich and INRIA Grenoble.

8.3.2. Visits of International Scientists

8.3.2.1. Internship

- Luca Scarnato, PhD student at Bern University, Switzerland, visited LEAR from July ’11 until August ’11. He worked on combining color and texture features for image categorization with Jakob Verbeek.

- Bo Geng, PhD student at Peking University, China, is visiting LEAR from November ’11 until April ’12. He works on attribute-based image retrieval.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. DW4RDF

**Participants:** Dario Colazzo, François Goasdoué, Ioana Manolescu, Alexandra Roatis.

This Digiteo DIM LSC (*Logiciels et Systèmes Complexes*) project has started in October 2011. The aim is to design and implement data warehouse-style models and technologies for Semantic Web data (or more generally for RDF). F. Goasdoué coordinates the project, which supports the PhD scholarship of A. Roatis.

8.1.2. EdiFlow

**Participants:** Wael Khemiri, Ioana Manolescu.

This Digiteo DIM LSC (*Logiciels et Systèmes Complexes*) project ends this year. We have attained our goal of building an efficient and expressive data visualization tool on top of a relational database management system (RDBMS) and published our results [33]. Follow-up work is clearly possible, in particular on more expressive workflow systems and in-memory data management coupled to visual analytics platforms.

8.1.3. Shiri

**Participants:** Yassine Mrabet, Nathalie Pernelle, Chantal Reynaud.

This Digiteo research project, led by N. Pernelle, ends this year. It involves two partners of Digiteo, Supelec and the University of Paris-Sud. The aim is to annotate and query documents that contain both semi-structured and textual data. This project supports the PhD scholarship of Y. Mrabet.

8.2. National Initiatives

In France, close links exist with groups at Orsay (proofs and programs, V. Benzaken; bio-informatics, C. Froidevaux; machine learning, M. Sebag; information visualization, J.-D. Fekete), with the Cedric Group at CNAM-Paris; some INRIA groups (Dahu, L. Segoufin, at INRIA-Saclay, Zenith, P. Valduriez at Montpellier; Exmo, J. Euzenat, at INRIA Rhone-Alpes; Mostrare at INRIA-Nord-Europe); some INSERM group (Ingénierie des connaissances e-santé, J. Charlet), the BIA group at INRA (P. Buche, C. Dervin), the IRIT of the University of Toulouse (N. Aussenac), the LIRMM of the University of Montpellier (M. Chein, M.-L. Mugnier), INRA/CIRAD Montpellier (P. Buche, S. Destercke and R. Thomopoulos) and INRA-AgroParisTech (J. Dibie-Barthélémy).

8.2.1. ANR Codex

**Participants:** Dario Colazzo, François Goasdoué, Konstantinos Karanasos, Ioana Manolescu.

The Codex ANR grant (ANR-2008-DEFIS-004) has been extended until 2012. We have finalized important parts of our work on materialized views for XML [41], [35] and for the Semantic Web [21].

8.2.2. ANR ConnectedClouds

**Participants:** Dario Colazzo, François Goasdoué, Ioana Manolescu, Jesús Camacho_Rodriguez.

This one-year ANR grant (2011-2012) concerns our research on cloud-based data management, in particular XML data. We have studied strategies for indexing XML content in a cloud-environment and built a prototype to test them.
8.2.3. **ANR DataBridges**

**Participants:** François Goasdoué, Ioana Manolescu, Nathalie Pernelle, Gianluca Quercini, Chantal Reynaud, Brigitte Safar, Fatiha Saïs.

This one-year ANR grant (2011-2012) is devoted to research on data integration in particular through the technologies and models of Open Data, with a particular interest in applications connected to the Digital Cities.

8.2.4. **ANR Dataring**

**Participants:** Asterios Katsifodimos, Ioana Manolescu.

The Dataring ANR grant has been extended until 2012. Within Dataring, we have proposed scalable algorithms for automatically recommending materialized XML views, in collaboration with V. Vassalos (AUEB, Greece). This has lead to a submitted publication.

8.2.5. **ANR Geonto**

**Participants:** Fayçal Hamdi, Nathalie Pernelle, Chantal Reynaud, Brigitte Safar, Fatiha Saïs.

This ANR Masses de Données et de Connaissances project (2008-2011) focused on geographic data interoperability. On one hand, we aim at integrating heterogeneous geographic databases using schema matching techniques. On the other hand, we aim at querying a large collection of textual documents which are more various and for a larger readership than databases. This project is a collaboration between COGIT-IGN (Sébastien Mustière), the IC3 group at IRIT - Université Paul Sabatier (Nathalie Aussenac) and the DESI group at LI-UPPA - Université de Pau et des Pays de l’Adour (Mauro Gaio). The home page of the project could be found at: [http://geonto.lri.fr](http://geonto.lri.fr).

8.2.6. **ANR PIMI**

**Participants:** Rania Khefifi, Fatiha Saïs.

The objectives of PIMI (Personal Information Management Through Internet) ANR project (2010-2013) are the definition of a design environment and a deployment platform for Personal Information Management System (PIMS). The future PIMS must provide the end-user personal data access with services that are relevant to his needs. Ontologies will be used to describe semantically the services and the user needs. Ontology matching techniques will be defined to compare the services and the user needs during the automatic service composition. In order to take mobility into account, the PIMS will be accessed both by mobile devices (smartphone) and Internet-connected Personal Computers. This project is a collaboration between Leo team, ForTesSE team from LRI, IRIT, IT (Institut Telecom), GENIGRAPH, Montimage, Région Midi-Pyrénées and CTIE from Luxembourg.

8.2.7. **ANR UNLOC**

**Participant:** Laurent Simon.

The UNLOC project (2008-2011) finishes this year. The project aims at studying and proposing new frameworks for SAT algorithms, based on more incompleteness. The Glucose 1.0, GlucosER and Glucose 2.0 systems were developed within this project.

8.2.8. **Participation to evaluation committees**

- C. Reynaud has participated to the evaluation committee of the non thematic ANR program "Blanc" Science Informatique et Application (SIMIZ) 2011 and of the thematic ANR program "Contenus numériques et interactions" (CONTINT) 2011.

8.3. **European Initiatives**

8.3.1. **FP7 Projects**

8.3.1.1. **Hycon2**
Title: Highly Complex and Networked Control Systems
Type: COOPERATION (ICT)
Defi: Engineering of Networked Monitoring and Control Systems
Instrument: Network of Excellence (NoE)
Duration: September 2010 - August 2014
Coordinator: CNRS (France)
Others partners: INRIA (France), ETH Zurich (Switzerland), TU Berlin (Germany), TU Delft (Netherlands) and many others
See also: http://www.hycon2.eu
Abstract: Hycon 2 aims at stimulating and establishing a long-term integration in the strategic field of control of complex, large-scale, and networked dynamical systems. It focuses in particular on the domains of ground and aerospace transportation, electrical power networks, process industries, and biological and medical systems.

8.3.1.2. Webdam
Title: Foundations of Web Data Management
Type: IDEAS
Instrument: ERC Advanced Grant (Advanced)
Duration: December 2008 - November 2013
Coordinator: INRIA (France)
Others partners: N/A
See also: http://webdam.inria.fr
Abstract: The goal of the Webdam project is to develop a formal model for Web data management. This model will open new horizons for the development of the Web in a well-principled way, enhancing its functionality, performance, and reliability. Specifically, the goal is to develop a universally accepted formal framework for describing complex and flexible interacting Web applications featuring notably data exchange, sharing, integration, querying and updating. We also propose to develop formal foundations that will enable peers to concurrently reason about global data management activities, cooperate in solving specific tasks and support services with desired quality of service. Although the proposal addresses fundamental issues, its goal is to serve as the basis for future software development for Web data management. S. Abiteboul has left Leo in September 2011. From this date, WebDam is no longer formally connected to the team, although collaborations with them continue.

8.3.2. Collaborations in European Programs, except FP7
8.3.2.1. KIC EIT ICT Labs DataBridges
Program: KIC EIT ICT Labs, “Digital Cities” Thematic Action Line
Project acronym: DataBridges
Project title: “Data Integration for Digital Cities”
Duration: January 2011 - December 2011
Coordinator: Ioana Manolescu (INRIA Saclay, Leo)
Other partners: IASI and BD teams from University of Paris 11; DFKI (Germany); TU Delft (The Netherlands); Aalto University (Finland); KTH (Sweden); Alcatel (France)
Abstract: Digital cities are information exchange marketplaces where companies, individuals, and administrations all interact through many-directional flows. Interesting recent development in this context are: the open data trend, aiming at making data freely shared by several parties, and the linked data technical initiative, leading to establishing connections across data sets toward integrating them. Our activity studies concrete and fundamental aspects connected to the creation, integration, personalization, and efficient sharing of open linked data in digital cities.

8.3.2.2. KIC EIT ICT Labs ConnectedCities

Program: KIC EIT ICT Labs, “Digital Cities” Thematic Action Line
Project acronym: ConnectedClouds
Project title: “Clouds for Connected Cities”
Duration: January 2011 - December 2011
Coordinator: Djamal Zeghlache (Télécom SudParis)
Other partners: IASI and BD teams from University of Paris 11; TU Berlin (Germany) etc.

Abstract: Digital cities are information exchange marketplaces where companies, individuals, and administrations all interact through many-directional flows. The ConnectedClouds activity aims at developing tools and techniques for efficiently gathering and managing large volumes of data within cloud-based platforms [62].

8.3.3. Major European Organizations with which you have followed Collaborations

Volker Markl: Technical University of Berlin, Database and Information Systems Lab (Germany)
Efficient management of Web data in a cloud environment

Cédric Pruski: Centre de Recherche Public Henri Tudor (CRP) (Luxembourg)
Reconciliation of Dynamic Medical Knowledge Organizing Systems

Giorgio Ghelli: Università di Pisa (Italy)
Type analysis of XML queries.

Carlo Sartiani: Università della Basilicata (Italy)
Type analysis of XML queries.

Vasilis Vassalos: Athens University of Economics and Business (Greece)
Materialized XML views: rewriting and view recommendation

8.4. International Initiatives

8.4.1. Visits of International Scientists

8.4.1.1. Internships

Francesca Bugiotti (from April 2011 until August 2011)
- Subject: Cloud-based management of RDF data
- Institution: Università di Roma Tré (Italy)

Giovanna Guerrini (from June 2011 until July 2011)
- Subject: XML update optimization
- Institution: Università di Genova (Italy)
Alexandra Roatis (from Mar 2011 until Aug 2011)
  • Subject: Semantic Web Data Management on ViP2P
  • Institution: West Timisoara University (Romania)

Vasiliki Papavasileou (from July 2011 until August 2011)
  • Subject: Efficient propagation of updates to multiple views
  • Institution: University of California in San Diego (USA)

Stamatis Zampetakis (from Jan 2011 until August 2011)
  • Subject: Models and Algorithms for Annotated Documents
  • Institution: University of Crete (Greece)
MAGRIT Project-Team (section vide)
MAIA Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. COMAC

Participants: Mauricio Araya, Marie Tonnelier, Vincent Thomas, Olivier Buffet, François Charpillet.

Laurent Bougrain (CORTEX team, LORIA) is an external collaborator.

The COMAC project is part of the Materalia competitive cluster. The main objective of the project is to develop diagnosis tools for the low cost identification of defaults in aeronautics parts made of composite materials.

In collaboration with Laurent Bougrain, one of our objectives is to propose a software toolbox for computer-aided diagnosis in this context. The current project is a system relying on expert knowledge taking the form of a database of labeled images.

In the MAIA team, our research effort focuses more precisely on information gathering problems involving active sensors, i.e., an intelligent system which has to select the observations to perform (which sensor, where, at which resolution). Mauricio Araya’s undergoing PhD looks precisely at the topic of Active Sensing (Section 5.1.8).

7.1.2. Multi-agent simulation of public transportation

Participant: Vincent Chevrier.

This collaboration with the CUGN (communauté urbaine du grand Nancy - Pole Transport) aims at a better understanding of the functioning of the transportation of the Grand-Nancy. A first part of the work aims at providing an accurate and meaningful understanding of the transportation system. Through student projects we propose different viewpoints to enhance this understanding. After validation of the Pole Transport, some of these viewpoints have been integrated in tools to produce daily report at the Pole Transport.

A second part is dedicated to the explanation of the dynamics of transportation systems. We are developing a multi-agent model of the tramway line which integrates real data (traveling time during stops). We are able to reproduce an equivalent functioning without perturbation. Recently, we showed that if we perturb the system, it responds similarly as the real system. For example, halting a tramway at a stop, figuring a lot of people being waiting and taking it, induces a comparable response in the simulator regarding to the real system.

7.2. National Initiatives

7.2.1. ANR project BARQ

Participants: Jörg Hoffmann, Olivier Buffet, Bruno Scherrer.

This project has been granted by ANR in the “Chaires d’Excellence” program. The project is funded with ca. 400000 EUR and will hire four non-permanent researchers (Doctorants and/or Postdocs). Jörg Hoffmann is the project leader, Olivier Buffet and Bruno Scherrer collaborate. Other collaborators from LORIA are Stephan Merz, Ammar Oulamara, and Martin Quinson. The project also has several international collaborators, in particular Prof. Blai Bonet (Universidad Simon Bolivar, Caracas, Venezuela), Prof. Carmel Domshlak (Technion Haifa, Israel), Prof. Hector Geffner (Universitat Pompeu Fabra, Barcelona, Spain), Dr. Malte Helmert (University of Freiburg, Germany), and Prof. Stephen Smith (CMU, Pittsburgh, USA).

8COMAC = contrôle optimisé multi-techniques des aérostructures composites / optimised multi-technique control of composite aeronautic parts
The project unites research from four different areas, namely classical planning, probabilistic planning, model checking, and scheduling. The underlying common theme is the development of new methods for computing lower bounds via state aggregation. Specifically, the basic technique investigated allows explicit selection of states to aggregate, in exponentially large state spaces, via an incremental process interleaving it with state space re-construction steps. The two main research questions to be addressed are how to choose the states to aggregate, and how to effectively obtain, in practical scenarios, anytime methods providing solutions with increasingly tighter performance guarantees.

So far, we have hired Dr. Michael Katz as a PostDoc (for 2 years) working on classical planning, and Manel Tagorti as a PhD student (for 3 years) working on probabilistic planning. The Conseil Regional de Lorraine has accepted to co-finance, for 2011, 50% of the the position of Michael Katz for a period of 1 year. Chao-Wen Perng was funded from BARQ for an internship of 5 months during which she worked on her MSc report, laying some basis for the research direction to be followed by Manel Tagorti.

### 7.2.2. PEPS project GEST - 2010/2011

**Participant:** Vincent Chevrier.

This project “Gouvernance Enactive des Systèmes de Transports” (GEST) is the consequence of the work undertaken within the GEST project funded by the IXXI (“Institut Rhône Alpin des Systèmes Complexes”).

It involves teams from the LIG (Laboratoire d’informatique de Grenoble) and from the LIERSP (Laboratoire d’informatique pour l’entreprise et les systèmes de production), and is associated to the CUGN.

This project aims at a fundamental level at proposing an enactive perspective for the governance issue in case of complex socio-technical systems, and more specifically, in case of public transportation systems. From a more applicative perspective, we seek at specifying a participatory and reflexive simulation system based on a multi-agent model.

This exploratory project is grounded on core ideas coming from the IXXI work. It aims at gathering researchers coming from different domains (social cognition, decision theory, simulation, serious game, etc) in order to clarify interdisciplinary issues.

A workshop was organized in the beginning of January 2011 in Lyon followed by three other meetings.

### 7.2.3. ANR project CARTOMATIC

**Participants:** Olivier Simonin, François Charpillet, Antoine Bautin.

This project has been granted by ANR in the Robotics Carotte challenge (CArtographie par ROboT d’un TERRitoire) from the *Contenus et Interactions* program. The project is funded with ca. 50000 EUR to purchase the robotics platform. The Maia team was also funded with a PhD fellowship. The Cartomatic consortium is formed by LISA/Angers University (leader), Maia/LORIA and Wany robotics (Montpellier).

This project concerns the mapping of an indoor structured but unknown environment, and the localization of objects, with one or several robots. We aim at studying multi-robot or swarm algorithms to achieve such a challenge, while showing the robustness and the accuracy of the mapping when using cooperation between several autonomous robots. In the work of Antoine Bautin PhD thesis (started in 2009) we have proposed a distributed algorithm XXXXXXXX multi-robot deployment and mapping. (Section 5.2.2.1).

### 7.2.4. INRIA AEN PAL Personally Assisted Living

**Participants:** François Charpillet, Olivier Simonin.

The PAL project is an INRIA National Initiative (Action d’Envergure Nationale) involving several teams of the institute (Arobas, Coprin, E-motion, Lagadic, Demar, Maia, Prima, Pulsar and Trio). It is coordinated by David Daney (INRIA Sophia-Antipolis EPI Coprin). The project focuses on the design of smart home and robot assistant. Maia is particularly involved in the People Surveillance work package, by studying and experimenting intelligent environments, funded on smart tiles (cf. Sec. 5.2.3.1) and multi-sensor devices.

As a first action, the consortium organized a Workshop ”De l’Autonomie au Domicile” in Nice, on November 29 & 30, 2010. [http://www-sop.inria.fr/coprin/pal/workshop/](http://www-sop.inria.fr/coprin/pal/workshop/)
7.2.5. **PEA-DGA SUSIE 2009-12**

**Participants:** François Charpillet, Olivier Simonin, Romain Mauffray.

This project relies on results and questions arising from the SMAART project (2006-08). During this project we adapted the EVAP algorithm 5.2.1.4 to the patrol with UAVs, while providing a generic digital pheromone based patrolling simulator Concerning sharing authority, we proposed an original interface to manipulate groups of UAVs. However, experiments with operators have shown that they succeed in improving the whole system when dealing with the patrolling task.

So, the aim of the SUSIE project is twofold: (i) studying and improving parameters of the EVAP algorithm through the SMAART simulator, (ii) defining new ways to manipulate pheromones fields in order to improve the sharing authority.

7.2.6. **INRIA ADT project ROMEA (2009-11)**

**Participants:** Olivier Simonin, François Charpillet, Nicolas Beaufort, Alain Dutech, Olivier Buffet.

ROMEA, for “RObots Mobiles et Environnements Actifs”, is a project proposed by the Maia team and funded by INRIA NGE through an ADT “Action de Developpement Technologique”. The project deals with the development and the study of intelligent and collective behaviors with Khepera III mobile robots. In particular we develop a new experimental device, called *interactive table for robots*, which provides a graphical active environment where robots can read and write pieces of information (e.g. digital pheromones). During 2010, with O. Rochel (INRIA research engineer) and N. Beaufort (INRIA IJD), we designed such a device which is now used for swarm robotics experiments, see Section 5.2.2.2. Nicolas Beaufort was hired for a second year as an INRIA IJD engineer to develop the required functions on the interactive table and the robots.

7.2.7. **CNRS PEPII project “IMAVO” (2011-2012)**

**Participant:** Alain Dutech.

IMAVO, for “Interactions entre Modules pour l’Apprentissage dans un environnement VOlatile”, is a PEPII project of the INSB institute of the CNRS. It involves Alain Marchand and Etienne Coutureau from the INCIA Lab of Bordeaux (Behavioral Neurosciences - INSB), Mehdi Khamassi and Benoît Girard from the ISIR Lab of Paris (Robotics and Neurosciences - INS2I), Alain Dutech and Nicolas Rougier from the Loria Lab of Nancy (Computational Neurosciences and Machine Learning - INS2I).

This project investigates *model-based* and *model-free* reinforcement learning approaches for rats learning in volatile environments (i.e. context and reward can change during learning). It aims at designing new concept for modularized decision-making systems, allowing a better understanding of the underlying neuro-biological process involved in rats and humans and applications in the field of autonomous robotics.

It is a logical extension of a cooperation between MaIA and the INCIA Lab of Bordeaux [7].

7.3. **European Initiatives**

7.3.1. **Collaborations in European Programs, except FP7**

7.3.1.1. **Agent Technical Fora**

The Agent Technical Fora have been created by AgentLink III. and consist of several working groups called Technical Forum Groups. These groups of researchers and developers share an interest in a specific sub-area of agent and multi-agent technology. Since the end of AgentLink, the Technical Fora have been organized jointly to the EUMAS conference, starting in 2006.

7.3.1.1.1. **Technical Forum Group: “Self-Organization”**

**Participants:** Christine Bourjot, Vincent Chevrier, Vincent Thomas.

Vincent Chevrier was promoter of the Technical Forum Group “Self Organization”. The aim of the TFG is to work on self-organization in complex distributed systems such as multi-agent systems. The group members have been involved in the writing of a book entitled *Self-Organising Software - From Natural to Artificial Adaptation* where the MAIA team is responsible for two chapters [44], [45].
7.3.1.1.2. Technical Forum Group: Simulation

**Participants:** Vincent Chevrier, Julien Siebert.

The Simulation Technical Forum meets for the first time this year. It aims at working on the main challenges of agent and multi-agent-based simulation while establishing links between members of the simulation community which could lead to share common research activities and projects.

The promoters of this forum solicited MAIA members to present their point of view on current issues in multiagent simulation.

7.3.1.2. European project INTERREG IVB “InTraDE” (2009-12)

**Participants:** François Charpillet, Alexis Scheuer, Olivier Simonin, Olivier Buffet.

The InTraDE project (Intelligent Transportation for Dynamic Environments, [http://www.intrade-nwe.eu/](http://www.intrade-nwe.eu/)) is funded by the European North West Region. The project is coordinated by Rochdi Merzouki from University of Science and Technology of Lille (LAGIS lab.). Other partners are the Maia team, Liverpool John Moores University (LOOM), the National Institute for Transport and Logistics in Dublin Institute of Technology, the South East England Development Agency, the AGHO Port of Oostende and the CRITT in Le Havre. In the context of seaports and maritime terminals, the InTraDE project aims to improve the traffic management and space optimization inside confined spaces by developing a clean and safe intelligent transportation system. This transportation system will operate in parallel with virtual simulation software of the automated site, allowing a robust and real-time supervision of the goods handling operation.

The Maia team partner focuses on decentralized approaches to deal with the control of automated vehicle platooning and the adaptation of the traffic. Maia is funded with two PhD fellowships and one engineer. Both PhD thesis started in the end of 2010. The PhD of Jano Yazbeck, supervised by F. Charpillet and A. Scheuer, aims at studying a “Secure and robust immaterial hanging for automated vehicles”. The PhD of Mohamed Tlig, supervised by O. Simonin and O. Buffet, addresses “Reactive coordination for traffic adaptation in large situated multi-agent systems”.

7.3.2. Major European Organizations with which you have followed Collaborations

- University of Basel, Departement Informatik (Switzerland)
  - New lower-bound heuristics for deterministic planning

  Partner 2: organisme 2, labo 2 (pays 2)
  Sujet 2 (max. 2 lignes)

7.4. International Initiatives

7.4.1. Visits of International Scientists

- Dr. Sylvie Thiébaux, Director of the Canberra Research Laboratory of NICTA (Australia), visited MAIA for 1 week in June 2011.
- Dr. Ingo Weber, Senior Research Associate at the University of New South Wales (Sydney, Australia), visited MAIA for 1 day in August 2011.
- Dr. Iadine Chadès, Research Scientist at CSIRO, Ecosystem Sciences division (Brisbane, Australia), visited MAIA for 1 week in September 2011.
- Dr. Van Parunak, Chief Scientist at Vector Research Center, Ann Arbor, USA, visited MAIA for 2 days at the occasion of Olivier Simonin’s HDR defense. December 2010.
8. Partnerships and Cooperations

8.1. International initiatives

8.1.1. Associate Team VERSAMUS with the University of Tokyo

Participants: Emmanuel Vincent, Nobutaka Ito, Gabriel Sargent, Ngoc Duong, Frédéric Bimbot, Rémi Gribonval.

Duration: 3 years, starting in January 2010.

Partner: Lab#1, Department of Information Physics and Computing, the University of Tokyo (JP)

We initiated a partnership with Lab#1 of the Department of Information Physics and Computing of the University of Tokyo, led by Shigeki Sagayama and Nobutaka Ono. This collaboration was formalized as the INRIA Associate Team VERSAMUS in January 2010. The PhD of Nobutaka Ito is co-supervised by Nobutaka Ono, Emmanuel Vincent and Rémi Gribonval in this framework. A workshop was organized in Tokyo in June 2011, and a total of 5 visits were made between the two teams in 2011.

The aim of this collaboration is to investigate, design and validate integrated music representations combining many acoustic and symbolic feature levels. Tasks to be addressed include the design of a versatile Bayesian model structure, of a library of probabilistic feature models and of efficient algorithms for parameter inference and model selection. More details are available on http://versamus.inria.fr/.
8. Partnerships and Cooperations

8.1. European Initiatives

8.1.1. FP7 Network of Excellence IRIS: Integrating Research in Interactive Virtual Storytelling

Participants: Stéphane Donikian [contact], Marc Christie [contact], Christophe Lino, Julian Joseph.

The IRIS project (Integrating Research in Interactive Storytelling) is a 3-year Network of Excellence project funded by the European Commission (FP-7 Grant Agreement 231824), from Jan. 2009 to Dec. 2011. The project gathers 10 academic partners: University of Teeside (project coordinator UK), INRIA (FR), Fachhochschule Erfurt (DE), TECFA Geneve (CH), Vrije Universiteit Amsterdam (NL), Universität Augsburg (DE), Université La Rochelle (FR), OFAI Vienne (AT) and Newcastle University (UK).

IRIS (Integrating Research in Interactive Storytelling) aims at creating a virtual centre of excellence that will be able to achieve breakthroughs in the understanding of interactive storytelling and the development of corresponding technologies. It is organised around four major objectives:

- To extend interactive storytelling technologies in terms of performance and scalability, so that they can support the production of actual interactive narratives
- To make the next generation of interactive storytelling technologies more accessible to authors and content creators of different media backgrounds (scriptwriters, storyboards, game designers)
- To develop a more integrated approach to interactive storytelling technologies, achieving a proper integration with cinematography
- To develop methodologies to evaluate interactive storytelling systems as well as the media experience of interactive narrative

8.1.2. FP7 STREP Fet-Open Tango

Participants: Julien Pettré [contact], Jonathan Perrinet, Anne-Hélène Olivier.

The goal of the TANGO project is to take some familiar ideas about affective communication one radical step further by developing a framework to represent and model the essential interactive nature of social communication based on non-verbal communication with facial and bodily expression. Indeed, many everyday actions take place in a social and affective context and presuppose that the agents share this context. But current motion synthesis techniques, e.g. in computer graphics, mainly focus on physical factors. The role of other factors, and specifically psychological variables, is not yet well understood.

In 2011, we conducted an experimental study on the effect of emotions during physical interactions between people. We focused the case of locomotion. We studied various situations of interaction such as collision avoidance or walking together. We asked professional actors to play such situation under conditions of emotions. Preliminary results show some emergent behavior, such as some leader-follower relations between people that depend on emotional context.
8.2. International Initiatives

8.2.1. INRIA International Partners

- University of North Carolina at Chapel Hill, GAMMA Group, with Professor Ming Lin and Dinesh Manocha: exchanges of master and PhD students on crowd simulation and motion planning for autonomous characters. Preparation of an INRIA Associated Team proposal for 2012.

- State Key Lab CAD&CG, Zheijiang Univ., China: 1-year stay of Xiubo Liang, PhD Student, in France to work on the gestures recognition for the French Sign Language.

- University of Montreal, Département d’informatique et de recherche opérationnelle (DIRO) with Jean Meunier: 1.5 years stay of Edouard Auvinet, a co-supervised PhD student who is working on falling detection and prevention through computer vision and simulation approaches.

- University of Barcelona, Event Lab, with Mel Slater: co-supervision of a PhD student (Anne-Marie Burns) who is working on using VR for serious training in sports.

- Queen’s University Belfast, psychology school, Cathy Craig (ERC Grant): co-supervision of Sebastien Brault, PhD student who is working on analyzing perception-action coupling in duels using immersive systems.

- National Chengchi University, Taiwan with Professor Tsai-Yen Li: Exchange of students and researchers around Smart motion planning using semantic annotations to augment path planning capacities for characters and cameras.

8.2.2. Visits of International Scientists

- Invited professor: William Bares (Millsaps College, USA) for three months (ISTIC grant), on the topic of virtual camera tracking.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Gina (Inria ADT, 2009-2011)

Participants: Nicolas Bremard, Samuel Degrande, Laurent Grisoni [correspondant], Damien Marchal.

This technology development activity aims at proposing a low-cost free-hand interaction system, that can be used flexibly in arbitrary configuration, using previous team results (start oct 2009, end nov 2011). During both years of this ADT, collaboration has been made with Le Fresnoy (National Studio of Contemporary Art) School (http://www.lefresnoy.net), for the Panorama exhibitions (one month, from early June to early July each year). Each year, two artistic installation have been put up in collaboration with artists from this school; in 2010-2011, the two installation used a Kinect as the acquisition device for interaction.

8.1.2. Boing (Inria ADT, 2010-2012)

Participants: Damien Marchal, Paolo Olivo, Nicolas Roussel [correspondant].

This project aims at creating a software toolkit to facilitate research on tactile and gestural interaction with the following goals in mind: it should make it easy to handle different hardware and software configurations, to compare existing interaction techniques, to develop new ones and to make them available to other people. See [23] for a description of the motivation for this work and preliminary results.

8.2. National Initiatives

8.2.1. Reactive (ANR TecSan, 2008-2011)

Participants: Géry Casiez, Jean-Philippe Deblonde, Frédéric Giraud, Laurent Grisoni [correspondant].

This project addressed rehabilitation for patients who suffered cerebrovascular accident (CVA). It aimed at proposing new VR-based tools for rehabilitation to improve patient involvement into his/her own rehabilitation, by proposing attractive training exercises and increase transfer of recovered skills, from exercises to real-life situations[14].

Partners: Hopale Fundation (coordinator), Inria [Mint], CEA-LIST, Idées-3com

Web site: http://reactive.berck-handicap.com/

8.2.2. InSTInCT (ANR ContInt, 2009-2012)

Participants: Géry Casiez [correspondant], Frédéric Giraud, Laurent Grisoni, Anthony Martinet, Nicolas Roussel.

This project focuses on the design, development and evaluation of new simple and efficient touch-based interfaces, with the goal of bringing widespread visibility to new generations of interactive 3D applications.

Partners: Inria [Mint, Iparla], Immersion, Cap Sciences

Web site: http://anr-instinct.cap-sciences.net/

8.3. European Initiatives

8.3.1. SHIVA (InterReg II-Seas, 2010-2013)

Participants: Fabrice Aubert, Géry Casiez, Samuel Degrande, Laurent Grisoni [correspondant], Damien Marchal, Yosra Rekik, Nicolas Roussel.
This project aims at providing virtual reality-based tools for sculpting, targeted on virtual rehabilitation, and children with disabilities. Sculpting was traditionally used within medical context, and has been removed because of practical cost, and also hygienic aspects. In this project, we plan to built up tools for virtual sculpting through adapted interface, and propose a set of exercises that would involved cognitive skills of user (assembly, object reproduction, boolean operations, etc.).

Partners: Inria [Mint, project coordinator], Hopale Fundation, University of Bournemouth, Victoria school in Poole.


8.4. International Initiatives

8.4.1. Visits of International Scientists

- Masaya Takasaki (Saitama University, June 2011)
- Dan Vogel (University of Waterloo, June 2011)
- Bruno De Araujo (University of Lisbon, sept-dec 2011)
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. BQR Grenoble INP IDEAL

Participants: Dobrina Boltcheva, Franck Hétroy.

3D models, coming for instance from engineering fields, are often “idealized”, or “simplified” (topologically speaking), in order to be used for simulation. The goal of this project IDEAL, funded by Grenoble INP, is to study these models, in particular the most general ones which are called “non-manifolds” and which are not handled by current softwares. We collaborate in this project with the University of Genova in Italy (Leila De Florian). 

8.2. National Initiatives

8.2.1. ANR project Morpho – Analysis of Human Shapes and Motions

Participants: Franck Hétroy, Lionel Reveret, Edmond Boyer.

MORPHO is aimed at designing new technologies for the measure and for the analysis of dynamic surface evolutions using visual data. Optical systems and digital cameras provide a simple and non invasive mean to observe shapes that evolve and deform and we propose to study the associated computing tools that allow for the combined analyses of shapes and motions. Typical examples include the estimation of mean shapes given a set of 3D models or the identification of abnormal deformations of a shape given its typical evolutions. Therefore this does not only include static shape models but also the way they deform with respect to typical motions. It brings a new research area on how motions relate to shapes where the relationships can be represented through various models that include traditional underlying structures, such as parametric shape models, but are not limited to them. The interest arises in several application domains where temporal surface deformations need to be captured and analyzed. It includes human body analyses but also extends to other deforming objects, sails for instance. Potential applications with human bodies are anyway numerous and important, from the identification of pathologies to the design of new prostheses. The project focus is therefore on human body shapes and their motions and on how to characterize them through new biometric models for analysis purposes. 3 academic partners will collaborate on this project: the INRIA Rhône-Alpes with the Perception team and the Evasion team, the GIPSA-lab Grenoble and the INRIA-Lorraine with the Alice team.

Website: http://morpho.inrialpes.fr/.

8.2.2. ANR project MADRAS

Participants: Romain Arcila, Franck Hétroy.

This 3-year and half project, funded by ANR, started on January 1st, 2008. Its goal is threefold:

- create a repository of 3D and 3D+t mesh models, together with ground truth segmentations (either done manually or automatically)
- use human perception to enhance conception and evaluation of segmentation algorithms
- develop new segmentation techniques for 3D and 3D+t meshes, using human perception and results of subjective experiments

On this project, Morpheo focuses on sequences of meshes evolving through time. Other partners are LIFL in Lille and LIRIS in Lyon.
Website: http://www-rech.telecom-lille1.eu/madras/.

8.2.3. Quaero Project

Participants: Benjamin Petit, Edmond Boyer.

Quaero is a program promoting research and industrial innovation on technologies for automatic analysis and classification of multimedia and multilingual documents. The partners collaborate on research and the realisation of advanced demonstrators and prototypes of innovating applications and services for access and usage of multimedia information, such as spoken language, images, video and music. The consortium is composed of French and German public and private research organisations. It is coordinated by Technicolor. The Morpheo team is participating in the project for the development of visual gesture interfaces with the objective to ease access to multimedia information.

8.2.4. ADT Vgate

Participants: Jean-Sébastien Franco, Edmond Boyer.

The ADT (Action de Developpement Technologique) Vgate was proposed in the context of the Grimage interactive and immersive platform. The objective of Vgate is to manage the evolution of the Grimage platform both on the hardware and software sides to ensure improvements, reusability and durations of the Grimage platform perception and immersion capabilities. Vgate was proposed in collaboration with the EPI Moais from the INRIA Grenoble Rhône-Alpes.

8.2.5. PlantScan3D project

Participants: Dobrina Boltcheva, Franck Hétroy.

This project is in collaboration with Vitual Plants and Galaad teams. Its objective is to develop the use of laser scanner for plant geometry reconstruction, in partnership with biologists-agronomists from several teams in France and Europe.

8.3. European Initiatives

8.3.1. Collaborations in FP7 European Programs

8.3.1.1. Project RE@CT

Participants: Jean-Sébastien Franco, Edmond Boyer.

Program: FP7 ICT STREP
Project acronym: RE@CT
Project title: IMMERSIVE PRODUCTION AND DELIVERY OF INTERACTIVE 3D CONTENT
Duration: 12/2011 - 12/2013
Coordinator: BBC (UK)
Other partners: Fraunhofer HHI (Germany), University of Surrey (UK), Artefacto (France), OMG (UK).
Abstract: RE@CT will introduce a new production methodology to create film-quality interactive characters from 3D video capture of actor performance. Recent advances in graphics hardware have produced interactive video games with photo-realistic scenes. However, interactive characters still lack the visual appeal and subtle details of real actor performance as captured on film. In addition, existing production pipelines for authoring animated characters are highly labour intensive. RE@CT aims to revolutionise the production of realistic characters and significantly reduce costs by developing an automated process to extract and represent animated characters from actor performance capture in a multiple camera studio. The key innovation is the development of methods for analysis and representation of 3D video to allow reuse for real-time interactive animation. This will enable efficient authoring of interactive characters with video quality appearance and motion. The project builds on the latest advances in 3D and free-viewpoint video from the contributing project partners. For interactive applications, the technical challenges are to achieve another step change in visual quality and to transform captured 3D video data into a representation that can be used to synthesise new actions and is compatible with current gaming technology.
8.3.2. Collaborations in European Programs, except FP7

8.3.2.1. Project iGlance

Participants: Gaëtan Janssens, Edmond Boyer.

Program: MEDEA
Project acronym: iGlance
Duration: 09/2008 - 09/2011
Coordinator: ST Micro Electronics
Other partners: Philips research (Holland), the university of Eindhoven (Holland), 4D View solutions (France), Silicon Hive (Holland), Logica (France), Task 24 (Holland), Verum (Holland), Tima (France).

Abstract: The primary goal of the iGlance project is to define a complete end-to-end 3D image chain for both consumer 3DTV applications and healthcare applications. The project includes the study and the realization of a 3DTV receiver that will be compliant with the consumer market requirements in term of cost, time to market, and interoperability.

The secondary goal of the project is to take benefits of the received 3D data to make interactive free viewpoint selection possible in 3D TV broadcasted media. This means that the viewer can select and interactively change the viewpoint of a stereoscopic streamed video. The interactivity is enabled by broadcasting a number of video streams from several viewpoints, consisting of a traditional 2D video and additionally depth information for each frame. Any desired view location in-between is generated by free viewpoint interpolation, using the depth information. The interpolated images are then displayed on a stereoscopic screen, giving a 3D impression to the audience.

8.3.3. Major European Organizations with which you have followed Collaborations

8.3.3.1. Universita di Genova, Dipartimento di Informatica e Scienze dell’Informazione (Italy)

In the context of the IDEAL project (jointly with the IMAGINE Inria team), we investigate with Leila de Florianij the topological decomposition of simplicial shapes, in order to classify of non-manifold singularities.

8.3.3.2. Forest Research, Centre for Forestry and Climate Change (UK)

As part of the PlantScan3D project, we work with Eric Casella on processing laser scans of trees and plants. More specifically, we try to recover global and local information about the plant from a single point cloud, without normals nor color information.

8.4. International Initiatives

8.4.1. INRIA Associate Teams

From the previous EVASION project, Franck Hetryo and Lionel Reveret were involved into the Associate Team SHARE. This project targets 3D modeling and animation of complex shapes such as animals in motion. It gathered the INRIA project EVASION and the Computer Graphics Department of UBC (University of British Columbia, Canada). Works have been done on the visual perception of 3D animation and its application in compression of 3D animation (Franck Hetryo and Ron Rensink). Another collaboration has been done on video motion capture and physical simulation of quadrupeds (Stelian Coros, Michiel van de Panne, Lionel Reveret). This last works has been published at SIGGRAPH 2011 [6].

8.4.2. Participation In International Programs

8.4.2.1. PHC project Temporally Consistent 3D Reconstruction and Action Recognition with a Multiple-Camera System

This is a “Partenariat Hubert Curien” (PHC) between the Technical University of Munich, Germany and MORPHEO (2010-11). The scientific objectives of this collaboration aim at the advancement of temporal aspects of the 3D reconstruction of dynamic scenes and the human action recognition in multiple-camera systems.
MOSTRARE Project-Team

8. Partnerships and Cooperations

8.1. National Actions

8.1.1. ANR Lampada (2009-2013)

Participants: Marc Tommasi [correspondent], Rémi Gilleron, Aurélien Lemay, Fabien Torre, Gemma Garriga.

The Lampada project on “Learning Algorithms, Models and sPArse representations for structured DAta” is coordinated by Tommasi from Mostrare. Our partners are the SEQUEL project of Inria Lille Nord Europe, the LIF (Marseille), the HUBERT CURIEN laboratory (Saint-Etienne), and LIP6 (Paris). More information on the project can be found on http://lampada.gforge.inria.fr/.

Lampada is a fundamental research project on machine learning and structured data. It focuses on scaling learning algorithms to handle large sets of complex data. The main challenges are 1) high dimension learning problems, 2) large sets of data and 3) dynamics of data. Complex data we consider are evolving and composed of parts in some relations. Representations of these data embed both structure and content information and are typically large sequences, trees and graphs. The main application domains are web2, social networks and biological data.

The project proposes to study formal representations of such data together with incremental or sequential machine learning methods and similarity learning methods.

The representation research topic includes condensed data representation, sampling, prototype selection and representation of streams of data. Machine learning methods include edit distance learning, reinforcement learning and incremental methods, density estimation of structured data and learning on streams.

8.1.2. ANR Defis Codex (2009-2012)

Participants: Joachim Niehren [correspondent], Sławek Staworko, Aurélien Lemay, Sophie Tison, Anne-Cécile Caron, Jérôme Champavère.

The Codex project on “Efficiency, Dynamicity and Composition for XML Models, Algorithms, and Systems” and is coordinated by Manolescu (GEMO, INRIA Saclay). The other partners of Mostrare there are Geneves (WAM, INRIA Grenoble), COLAZZO (LRI, Orsay), Castagna (PPS, Paris 7), and Halfeld (Blois). Public information on Codex can be found on http://codex.saclay.inria.fr/.

The Codex project seeks to push the frontier of XML technology in three interconnected directions. First, efficient algorithms and prototypes for massively distributed XML repositories are studied. Second, models are developed for describing, controlling, and reacting to the dynamic behavior of XML collections and XML schemas with time. Third, methods and prototypes are developed for composing XML programs for richer interactions, and XML schemas into rich, expressive, yet formally grounded type descriptions.

8.1.3. ANR Blanc Enum (2007-2011)

Participants: Guillaume Bagan, Joachim Niehren [correspondent], Sophie Tison.

The Enum project on “Complexity and Algorithms for Answer Enumeration”, is coordinated by A. Durand (Paris VII). The other partners are E. Grandjean (University of Caen), N. Creignou (University of Marseille). Public information on Enum can be found on http://enumeration.gforge.inria.fr/.

Enum studies algorithmic and complexity questions of answers enumeration, the task of generating all solutions of a given problem. Answer enumeration requires innovative efficient algorithms that can quickly serve large numbers of answers on demand. The prime application is query answering in databases, where huge answer sets arise naturally.
8.1.4. ARC ACCESS (2010–2011)

Participants: Iovka Boneva [correspondent], Sophie Tison, Anne-Cécile Caron, Yves Roos, Benoît Groz, Sławek Staworko.

This is a collaboration on the subject Access Control Policies for XML: Verification, Enforcement and Collaborative Edition, supported by the INRIA Collaboration Program (Action de Recherche Collaborative). The other participants involved are from the INRIA teams DAHU (INRIA Saclay – Île de France), PAREO and CASSIS (INIRA Nancy – Grand Est). This project is concerned with the security and access control for Web data exchange, in the context of Web applications and Web services. We aim at defining automatic verification methods for checking properties of access control policies (ACP) for XML, like consistency or secrecy, and for the comparison ACPs. One of our goals is to apply formal tools from tree automata theory for this purpose. A second important goal is to design efficient methods for ACP enforcement for secure query evaluation. We will study several scenarios for solving different variants of this problem, based on the notion of secure user views. As a case study, we will apply our methods to an XML-based collaborative editing system.

8.2. International Initiatives

8.2.1. INRIA Associate Teams

8.2.1.1. TRANSDUCE

Title: Automatic XML Data Conversion through Tree Transducers
INRIA principal investigator: Joachim Niehren
International Partner:
   Institution: NICTA Sydney (Australia)
   Laboratory: XML Query Technologies project
Duration: 2010 - 2012
See also: https://gforge.inria.fr/plugins/wiki/index.php?id=390&type=g

Data conversion between XML formats is a frequent, complex, and repetitive engineering task. It needs to be solved for data publishing, peer-to-peer data exchange, document processing, information extraction, and Web services. In this project, we propose to develop automatic methods generating conversion programs from examples, so that they can be used by non-expert users. Our approach is based on learning of tree transducers and XML queries.

8.2.2. Visits of International Scientists

Sebastian MANETH from NICTA Sydney visited us May-July 2011. He now moved to the University of Leipzig. In 2010-11, this cooperation was funded by the INRIA associate team program.

8.2.3. Participation In International Programs

MOSTRARE, in collaboration with SEQUEL and Rouen, is part part of the Inria Lille - Nord Europe site for the European Network of Excellence in Pattern Analysis, Statistical Modelling and Computational Learning (PASCAL2).
8. Partnerships and Cooperations

8.1. International projects and collaborations

8.1.1. Fapemig INRIA Project: Incorporating knowledge models into scalable data mining algorithms

Participants: Mehdi Kaytoue, Amedeo Napoli [contact person], Chedy Raïssi.

This Fapemig – INRIA research project involves researchers at Universidade Federal de Minas Gerais in Belo Horizonte –a group led by Prof. Wagner Meira– and the Orpailleur team at INRIA Nancy Grand Est. In this project we are interested in the mining of large amount of data and we target two relevant application scenarios where such issue may be observed. The first one is text mining, i.e. extracting knowledge from texts and document categorization. The second application scenario is graph mining, i.e. determining relationship-based patterns and use these relations to perform classification tasks. In both cases, the computational complexity is large either because the high dimensionality of the data or the complexity of the patterns to be mined.

One strategy to ease the execution of such data mining tasks is to use existing knowledge to restrict the search space and to assess the quality of the patterns found. This existing knowledge may be formalized in ontologies but also in other ways whose study is a research issue in this project. Once we are able to build knowledge models, we need to determine how to use such knowledge models, which is a second major research issue in this project. In particular, we want to design and evaluate mechanisms that allow the exploitation of existing knowledge for sake of improving data mining algorithms.

Finally, the computational complexity of the algorithms remains a major issue and we intend to address it through parallel algorithms. Data mining algorithms, in general, represent a challenge for sake of parallelization because they are irregular and intensive in terms of both computing and communication. Accordingly, in a first joint work, we developed a new parallel algorithm to build skycubes based on the Anthill framework developed at UFMG. The paper was presented in a local Brazilian Conference and an extended journal version will appear in a 2012 special issue of the International Journal of Parallel Programming.

8.1.2. Search for anti-HIV drugs acting as entry-blockers

Participants: Thomas Bourquard, Marie-Dominique Devignes, Anisah Ghoorah, Lazaros Mavridis, Violeta Pérez-Nueno, Dave Ritchie, Malika Smail-Tabbone, Vishwesh Venkatraman.

In collaboration with computational chemistry colleagues at the University of Bari and the Institut Chimique de Sarria (IQS) in Barcelona, Dave Ritchie has published reviews of the state of in silico protein structure modeling and virtual drug screening techniques for the CCR5 [87], and CXCR4 [111], entry-blocking molecules. As there now exist several hundred such entry-blockers, there is considerable interest in the chemoinformatics community in how best to use knowledge of known drug molecules to develop new and more potent new drug candidates [112]. The spherical harmonic clustering approach developed by Dave Ritchie and Violeta Pérez-Nueno was recently used successfully in a virtual screening study at the IQS to discover new high-affinity ligands for CXCR4 [109].

8.1.3. International collaborations in Mining complex data

Participants: Isiru Bayissa, Adrien Coulet, Mehdi Kaytoue, Amedeo Napoli, Chedy Raïssi.
A first collaboration involves “Université du Québec à Montréal” (UQAM) in Montréal with Prof. Petko Valtchev and Laboratoire LIRMM in Montpellier with Prof. Marianne Huchard. This collaboration is supported by a CNRS PICS project (2011-2014), which is called “Concept Analysis driving Ontology Engineering” and abbreviated in “CAdOE”. The research work within this project is aimed at defining and implementing a semi-automatic methodology supporting ontology engineering based on the joint use of Formal Concept Analysis (FCA) and Relational Concept Analysis (RCA). At the moment, some elements of this methodology are existing and were used in text mining [85], [84]. However, the first methodology should be completed and improved, especially regarding the applicability on complex data and the interoperability with knowledge representation modules. This year, some publications were already obtained and some others are in preparation for next year [36], [56], [75].

A second collaboration involves Sergei Kusnetsov at Higher School of Economics in Moscow (HSE). Mehdi Kaytoue and Amedeo Napoli visited HSE laboratory in July 2010 granted by the Poncelet Laboratory in Moscow, a joint CNRS – INRIA laboratory. This visit was the occasion of preparing a number of publications, among which a publication in a first-rank conference in Artificial Intelligence (major [5]), together with some other important publications [49], [33], [48]. This shows that the collaboration is on-going and that there is still a substantial research work to be done. This year, Amedeo Napoli visited HSE laboratory in June 2011 while Sergei Kuznetsov visited Loria in October 2011.

A third collaboration—a PHC Zenon project—exists with Florent Domenach, associated professor at the University of Nicosia in Cyprus. This project is entitled “Knowledge Discovery for Complex Data in Formal and Relational Concept Analysis” (KD4CD) and is aimed at studying and combining different types of classification process in the framework of FCA. These processes can be based on Galois connections but also on the so-called “overhangings”, i.e. a kind of generalization of closure systems. Moreover, another interest is put on consensus theory where the objective is to find the better classification of a set of objects according to a quality measure (this could be applied to ontologies). This year, there were two visits from France to Cyprus in May and December 2011 while there was one visit from Cyprus to France in October 2011.

8.2. European Initiatives

8.2.1. FP7 Projet: DOVSA

- Title: Development of Virtual Screening Algorithms: Exploring Multiple Ligand Binding Modes Using Spherical Harmonic Consensus Clustering.
- Type: PEOPLE.
- Instrument: Marie Curie Intra-European Fellowships for Career Development (IEF).
- Duration: July 2010 – July 2012.
- Coordinator: INRIA Nancy Grand-Est (France).
- Others partners: None.
- Abstract (see also Section 6.3.6 of this document):

This project will advance the state of the art in virtual drug screening by developing novel spherical harmonic-based consensus clustering algorithms. The main disease that will be targeted in this project is the acquired immune deficiency syndrome (AIDS), caused by the human immunodeficiency virus (HIV). However, the approach will be quite generic and will be broadly applicable to many other diseases. The approach will be tested and validated using 40 well-known drug targets from the DUD dataset. It will then be used to screen the French Chimiothèque Nationale library of some 36000 compounds for novel ligands which will bind the CCR5 co-receptor and hence block HIV infection. A small list of candidate entry-blocking compounds will be sent to Barcelona for experimental testing. By extending the SH-based consensus clustering technique, this project will provide a generic tool to help deal with cases where multiple ligands may be associated with multiple pocket sub-sites or which may bind multiple targets, and it will help to find new HIV entry-blocking compounds.
### 8.3. National Initiatives

#### 8.3.1. ANR Kolflow: man-machine collaboration in continuous knowledge-construction flows

**Participants:** Jean Lieder [contact person], Amedeo Napoli, Emmanuel Nauer, Julien Stévenot, Yannick Toussaint.

Kolflow (http://kolflow.univ-nantes.fr) is a 3-years basic research project taking place from February 2011 to July 2014, funded by French National Agency for Research (ANR), program ANR CONTINT. The aim of the project is investigation on man-machine collaboration in continuous knowledge-construction flows. Kolflow partners are Edelweiss (INRIA Sophia Antipolis), GDD (LINA Nantes), Silex (LIRIS Lyon), Orpailleur, and Score (LORIA).

#### 8.3.2. ANR Trajcan: a study of patient care trajectories

**Participants:** Elias Egho, Nicolas Jay [contact person], Amedeo Napoli, Chedy Raïssi.

Since 30 years, many patient classification systems (PCS) have been developed. These systems aim at classifying care episodes into groups according to different patient characteristics. In France, the so-called “Programme de Médicalisation des Systèmes d’Information” (PMSI) is a national wide PCS in use in every hospital. It systematically collects data about millions of hospitalizations. Though it is used for funding purposes, it includes useful knowledge for other public health domains such as epidemiology or health care planning.

The objective of the Trajcan project is to represent and analyze “patient care trajectories” (patient suffering from cancer limited to breast, colon, rectum, and lung cancers) and the associated healthcares. The data are related to patients receiving hospital cares in the “Bourgogne” region and using data from the PMSI. Such an analysis involves various data, e.g. type of cancer, number of visits, type of stays, hospitalization services and therapies used, and demographic factors, i.e. age, gender, place of residence.

One thesis is currently carried out on this subject whose objective is to design a knowledge discovery system working on multidimensional and sequential data for characterizing Patient Care Trajectories (PCT). This thesis combines knowledge discovery and knowledge representation methods for improving the definition of patient care trajectories as temporal objects (sequential data mining). The overall objective id to provide in decision support for improving healthcare in detecting for example typical or exceptional trajectories for planning with precision healthcare for a given population. In order to discover groups of patients showing similar health condition, treatments or journeys through the healthcare system, PCT are mined with multilevel and multidimensional sequential itemsets search, using external knowledge on hospitals, medical procedures and diagnoses. FCA capabilities for dealing with large amounts of data and for filtering (with a measure such as stability) are then used as a post-processing step for selecting the most interesting patterns [46].

### 8.4. Local initiatives

#### 8.4.1. Contrat Plan État Région” (CPER)

The links between the Regional Administration and LORIA are materialized through an administrative contract called “Contrat Plan État Région” (CPER) running from 2007 to 2013. The associated scientific program is called “Modélisations, informations et systèmes numériques” (MISN) and includes two tracks in which the Orpailleur team is involved.

- “Modeling Bio-molecules and their Interactions” (MBI).
  
  This project is coordinated by Marie-Dominique Devignes (http://bioinfo.loria.fr) and the general objective is to study how domain knowledge can be taken into account for improving modeling of biomolecules and their interactions, and how, in sequence, this guides the modeling of biological systems. Six scientific projects are currently under development and involve collaborations with computer scientists, and people working either in biology or chemistry.
An INRIA experimental research platform is currently developed in the framework of MBI (http://bioinfo.loria.fr/Plateforme%20MBI). This platform is aimed at sharing data and computing resources. Its specific features are relative to biomolecules modeling, classification, and to data integration for data mining. In parallel with the bioinformatics platforms in Strasbourg, Reims, Lille, and Nancy-INIST, it constitutes the North-East node of RENABI (“Réseau National des Plateformes Bioinformatiques”).

- “Traitement Automatique des Langues et des Connaissances” (TALC).

TALC has to be understood as “Automatic Processing of Languages and Knowledge” and the general objective is to study the relations existing between knowledge discovery, knowledge representation, reasoning, and natural language processing. In this framework, the Orpailleur team plays an important role as the research themes are closely related to those of the team. Actually, research projects are currently under development on knowledge management and decision support in the large involving in particular the Kasimir and the Taaable systems.

**8.4.2. Other initiatives**

8.4.2.1. **Cancéropole Grand-Est**

A collaboration with the “Laboratoire de Bioinformatique et Génomique Intégratives (LBGI)” at IGBMC Strasbourg involves a thesis funded by INCa (“Institut National du Cancer”) with a bipartite direction. This thesis is considered as one research operation within the annual meeting of “Canceropole Grand-Est”.

8.4.2.2. **BioProLor**

The Orpailleur team is member of the BioProLor consortium composed of 5 enterprises and 7 academic research teams. This consortium is funded for 2 years (2010-2012) by the AME (“Agence pour la Mobilisation Economique”). The objective of BioProLor is the design of a production filière for compounds with high added-value which originate from plants in Lorraine. The Orpailleur team and the associated start-up “Harmonic Pharma” are in charge of the computational aspects of this research work.

In addition, a CIFRE contract was set up with Harmonic Pharma for funding the thesis of Emmanuel Bresso on the following subject: “Organisation et exploitation des connaissances sur les réseaux d’interactions biomoléculaires pour l’identification de gènes candidats et la caractérisation de profils pharmacologiques et effets secondaires de principes actifs”.

8. Partnerships and Cooperations

8.1. International Contracts

8.1.1. CMCU - Tunis University

This cooperation involves the LSTS (Laboratoire des systèmes et Traitement du Signal) of Tunis University headed by Prof. Noureddine Ellouze and Kais Ouni. This new project involves the investigation of automatic formant tracking, the modelling of peripheral auditory system and more generally speech analysis and parameterization that could be exploited in automatic speech recognition.

8.1.2. The Oesovox Project 2009-2011: 4 international groups associated...

It is possible for laryngectomees to learn a substitution voice: the esophageal voice. This voice is far from being natural. It is characterized by a weak intensity, a background noise that bothers listening, and a low pitch frequency. A device that would convert an esophageal voice to a natural voice would be very useful for laryngectomees because it would be possible for them to communicate more easily. Such natural voice restitution techniques would ideally be implemented in a portable device. In order to answer the INRIA Euromed 3+3 Mediterranean 2006 call, the INRIA Parole group (Joseph Di Martino, LORIA senior researcher, Laurent Pierron, INRIA engineer and Pierre Tricot, Associated Professor at INPL-ENSEM) associated with the following partners:

- **Spain**: Begoña García Zapirain, Deusto University (Bilbao-Spain), Telecommunication Department, PAS-“ESOIMPROVE” research group.
- **Tunisia**: Sofia Ben Jebara, TECHTRA research group, SUP’COM, Tunis.
- **Morocco**: El Hassane Ibn-Elhaj, SIGNAL research group, INPT, Rabat.

This project named LARYNX has been subsidized by the INRIA Euromed program during the years 2006-2008. Our results have been presented during the INRIA 2008 Euromed colloquium (Sophia Antipolis, 9-10 October 2008). During this international meeting, The French INRIA institute decided to renew our project with the new name “OESOVOX”. This new project will be subsidized during the years 2009-2011.

In the framework of the European COADVISE-FP7 program, two PhD students have assigned to the Euromed 3+3 Oesovox project. These students are, Miss Fadoua Bahja from INPT-Rabat (Morocco) whose PhD thesis title is “Detection of F0 in real-time for audio: application to pathological voices” and Mr. Ammar Werghi from SUP’COM-Tunis (Tunisia) whose PhD thesis title is "Voice conversion techniques applied to pathological voice repair". The activity reports of these two students for the year 2009 is described in 6.1.6.

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7

Program: Interreg
Project acronym: Allegro
Project title: Adaptive Language LEarning technology for the Greater Region
Duration: 01/01/2009 to 31/12/2012
Coordinator: Saarland University
Other partners: Supélec Metz and DFK Kaiserslautern
Abstract: Allegro is an Interreg project (in cooperation with the Department of COmputational LInguiistics and Phonetics of the Saarland University and Supélec Metz) which started in April 2010. It is intended to develop software for foreign language learning. Our contribution consists of developing tools to help learners to master the prosody of a foreign language, i.e. the prosody of English by French learners, and then prosody of French by German learners. We started by recording (with the project Intonale) and segmenting of a corpus made up of English sentences uttered by French speakers and we analyzed specific problems encountered by French speakers when speaking English.

Program: Eurostar
Project acronym: Emospeech
Project title: Interagir naturellement et émotiennellement avec des environnements virtuels
Duration: 01/06/2009 to 01/06/2012
Coordinator: Artefacto
Other partners: Acapela Speech group

Abstract: The Emospeech project is an Eurostar project started on 1st June 2010 in cooperation with SMEs Artefacto (France) and Acapela (Belgium). This project comes within the scope of serious games and virtual worlds. If existing solutions reach a satisfying level of 3D physical immersion, they do not provide satisfactory natural language interactions. The objective is thus to add spoken interactions via automatic speech recognition and speech synthesis. EPI Parole and Talaris take part in this project and the contribution of Parole will be about the interaction between the virtual world, automatic speech recognition and the dialogue management.

8.3. International Initiatives

8.3.1. Visits of International Scientists

8.3.1.1. Internships

Nicolas VINUESA (from Mar 2011 until Aug 2011)

Subject: Dealing with automatic classification uncertainty in training acoustic models for speech recognition
Institution: Universidad Nacional de Rosario (Argentina)
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR Project

8.1.1.1. ROM

Program: ANR CONTINT
Project acronym: ROM
Project title: Realtime Onset Matchmoving
Duration: 2008 – 2011
Coordinator: Duran Duboi SA
Other partners: VORTEX (IRI Toulouse, France)

Abstract: This industrial R&D project concerns the generation of special effects for movie or other film productions. In particular, the goal is to provide tools for successful onset matchmoving, that is the estimation of camera trajectories during acquisition, with immediate pre-visualization of special effects superimposed on acquired sequences. Besides this real-time aspect of matchmoving, the project also addresses the problem of preparing a shooting, by analyzing if matchmoving with natural features is possible and if not, by instrumenting the scene with artificial markers in appropriate positions.

8.2. European Initiatives

8.2.1. FP7 Project

8.2.1.1. HUMAVIPS

Title: Humanoids with audiovisual skills in populated spaces
Type: COOPERATION (ICT)
Defi: Cognitive Systems and Robotics
Instrument: Specific Targeted Research Project (STREP)
Duration: February 2010 - January 2013
Coordinator: INRIA (France)
Others partners: CTU Prague (Czech Republic), University of Bielefeld (Germany), IDIAP (Switzerland), Aldebaran Robotics (France)

See also: http://humavips.inrialpes.fr

Abstract: Humanoids expected to collaborate with people should be able to interact with them in the most natural way. This involves significant perceptual, communication, and motor processes, operating in a coordinated fashion. Consider a social gathering scenario where a humanoid is expected to possess certain social skills. It should be able to explore a populated space, to localize people and to determine their status, to decide to join one or two persons, to synthetize appropriate behavior, and to engage in dialog with them. Humans appear to solve these tasks routinely by integrating the often complementary information provided by multi sensory data processing, from low-level 3D object positioning to high-level gesture recognition and dialog handling. Understanding the world from unrestricted sensorial data, recognizing people? intentions and behaving like them are
extremely challenging problems. The objective of HUMAVIPS is to endow humanoid robots with audiovisual (AV) abilities: exploration, recognition, and interaction, such that they exhibit adequate behavior when dealing with a group of people. Proposed research and technological developments will emphasize the role played by multimodal perception within principled models of human-robot interaction and of humanoid behavior. An adequate architecture will implement auditory and visual skills onto a fully programmable humanoid robot. An open-source software platform will be developed to foster dissemination and to ensure exploitation beyond the lifetime of the project.

8.2.2. ESA project

8.2.2.1. ITI 3D

Program: ESA ITI (European Space Agency Triangular Initiatives)
Project acronym: ITI 3D
Project title: Multi-View 3D Reconstruction of Asteroids
Duration: 2010 – 2011
Coordinator: EADS Astrium
Abstract: The goal of the project is to implement and validate algorithms for image-based 3D modeling of asteroids. The algorithms combine multi-view stereo and shape-from-shading.
8. Partnerships and Cooperations

8.1. European Initiatives

8.1.1. Major European Organizations with which you have followed Collaborations

EIT KIC ICTlabs

ICTLabs is the KIC for ICT (http://eit.ictlabs.eu/ict-labs/) ICTLabs is set up as a network of 5 "co-location" centers in Helsinki, Stockholm, Berlin, Paris, Eindhoven. The Paris node is run by INRIA with partners Alcatel Lucent, Orange, University Paris Sud and Institut Telecom. PRIMA actively participates in the thematic actions: Smart Spaces, Smart Energy Systems and Health and Well Being.

8.2. International Initiatives

8.2.1. INRIA International Partners

Since the PERSPOS project (BQR Grenoble INP 2008-2009), the MICA center (UMI 2954 CNRS) and PRIMA has a long time collaboration. We wish to develop the concept of "large-scale" perceptive space that is an intelligent environment which will be deployed on a large surface containing several buildings (as a university campus for example). The user is wearing one or many mobile intelligent wireless devices (telephone, Smartphone, PDA, notebook). Using all these devices, one can use many different applications (read emails, browse the Internet, file exchange, etc.). By combining the concepts of large-scale perceptive environments and mobile computing, we can create intelligent spaces to propose services adapted to individuals and their activities. Our collaboration is focussing the user location within such a smart space. Tracking people in smart environments remains a challenging fundamental problem. Whether it is at the scale of a campus, of a building or more simply of a room, we can dynamicaly combine several localization levels (and several technologies) to allow a more accurate and reliable user localization system. This collaboration was concrete with the Ph.D. thesis from Han Yue (started in November 2008). This thesis was co-supervised between Grenoble INP and Hanoi Polytechnical Institute.

8.2.2. Visits of International Scientists

8.2.2.1. Internships

Ch. A. V. Vijay

Subject: Visual fatigue assessment on stereoscopic movies based on image processing: will this 3-D movie give you a headache?

Institution: IIT Bombay (India)
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. National Projects

8.1.1.1. CIU-Santé

Program: DGCIS-FUI
Project acronym: CIU-Santé
Project title: Centre Innovation et Usage pour la Santé
Duration: November 2008- May 2012
Coordinator: Pôle de compétitivité SCS
Partners: CSTB, Sophia Antipolis (FR); Nice City Hospital, Nice (FR); Actis Ingenierie (FR), Movea (FR), CEA (FR); UNSA (FR).
See also: http://www.ciusante.org/
Abstract: CIU-Santé (Centre d’Innovation et d’Usages en Santé) is a DGCIS project to develop experiments in the domain of health. Two experimental rooms have been equipped in Nice-Cimiez Hospital for monitoring Alzheimer patients.

8.1.1.2. VIDEO-ID

Program: ANR Sécurité
Project acronym: VIDEO-ID
Project title: VideoSurveillance and Biometrics
Duration: February 2008-February 2012
Coordinator: Thales Security Systems and Solutions S.A.S
Other partners: INRIA; EURECOM; TELECOM and Management Sud Paris; CREDOF ; RATP
See also: http://www-sop.inria.fr/pulsar/projects/videoid/
Abstract: Using video surveillance, the VIDEO-ID project aims at achieving real time human activity detection including the prediction of suspect or abnormal activities. This project also aims at performing identification using face and iris recognition. Thanks to such identification, a detected person will be tracked throughout a network of distant cameras, allowing to draw a person’s route and his destination. Without being systematic, a logic set of identification procedures is established: event and abnormal behaviour situation and people face recognition.

8.1.1.3. SWEET-HOME

Program: ANRTecsan
Project acronym: SWEET-HOME
Project title: Monitoring Alzheimer Patients at Nice Hospital
Duration: November 2009-November 2012
Coordinator: CHU Nice Hospital (FR)
Other partners: INRIA (FR); LCS (FR); CNRS unit - UMI 2954, MICA Center in Hanoi (VN); SMILE Lab , National Cheng Kung University (TW); National Cheng Kung University Hospital (TW).
Abstract: SWEET-HOME project aims at building an innovative framework for modeling activities of daily living (ADLs) at home. These activities can help assessing elderly disease (e.g. Alzheimer, depression, apathy) evolution or detecting pre-cursors such as unbalanced walking, speed, walked distance, psychomotor slowness, frequent sighing and frowning, social withdrawal with a result of increasing indoor hours.

8.1.1.4. QUASPER

Program: FUI
Project acronym: QUASPER
Project title: QUAlification et certification des Systèmes de PERception
Duration: June 2010 - May 2012
Coordinator: THALES There SIS
Other partners: AFNOR; AKKA; DURAN; INRETS; Sagem Securité; ST Microelectronics; Thales RT; Valeo Vision SAS; CEA; CIVITEC; SOPEMEA; ERTE; HGH.
See also: [http://www.systematic-paris-region.org/fr/projets/quasper-rd](http://www.systematic-paris-region.org/fr/projets/quasper-rd)

Abstract: QUASPER project gathers 3 objectives to serve companies and laboratories: (1) to encourage R&D and the design of new perception systems; (2) to develop and support the definition of European standards to evaluate the functional results of perception systems; (3) to support the qualification and certification of sensors, software and integrated perception systems. Target domains are Security, Transportation and Automotive.

8.1.1.5. moniTORE

Program: FR-FC (Fédération nationale de Recherche Fusion par Confinement Magnétique - ITER)
Project acronym: moniTORE
Project title: Real Time Monitoring of Imaging Diagnostic Applied to Tore Plasma Operation.
Duration: 1 year
Coordinator: Imaging and Diagnostics Group of the CEA Cadarache
Other partners: INRIA Pulsar team

Abstract: moniTORE is an Exploratory Action called MONITORE for the real-time monitoring of imaging diagnostics to detect thermal events in a tore plasma. This work is a preparation for the design of the future ITER nuclear reactor.

Le projet monitore est une action soutenue et financee par la (FR-FCM Fédération nationale de Recherche Fusion par Confinement Magnétique - ITER) dont Pulsar est un laboratoire membre. pour la description : monitore = real time monitoring of imaging diagnostic applied to tore plasma operation.

8.1.2. Large Scale INRIA Initiative

8.1.2.1. PAL

Program: INRIA
Project acronym: PAL
Project title: Personally Assisted Living
Duration: 2010 -2014
Coordinator: COPRIN team
Others partners: AROBAS, DEMAR, E-MOTION, PULSAR, PRIMA, MAIA, TRIO, and LA-GADIC INRIA teams
See also: [http://www-sop.inria.fr/coprin/aen/](http://www-sop.inria.fr/coprin/aen/)
Abstract: The objective of this project is to create a research infrastructure that will enable experiments with technologies for improving the quality of life for persons who have suffered a loss of autonomy through age, illness or accident. In particular, the project seeks to enable development of technologies that can provide services for elderly and fragile persons, as well as their immediate family, caregivers and social groups.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. Co-FRIEND

Title: Cognitive Vision System able to adapt itself to unexpected situations
Type: COOPERATION (ICT)
Defi: Cognitive systems, interaction, robotics
Instrument: Specific Targeted Research Project (STREP)
Duration: February 2008 - January 2011
Coordinator: AKKA (FR) (France)
Others partners: Akka, Toulouse airport (FR); University of Reading and of Leeds (UK); Cognitive System Laboratory, University of Hamburg (G).
See also: http://www.co-friend.net
Abstract: The main objectives of this project are to develop techniques to recognize and learn automatically all servicing operations around aircraft parked on aprons.

8.2.1.2. VANAHEIM

Title: Autonomous Monitoring of Underground Transportation Environment
Type: COOPERATION (ICT)
Defi: Cognitive Systems and Robotics
Instrument: Integrated Project (IP)
Duration: February 2010 - July 2013
Coordinator: Multitel (Belgium)
Others partners: INRIA Sophia-Antipolis (FR); Thales Communications (FR); IDIAP (CH); Torino GTT (Italy); Régie Autonome des Transports Parisiens RATP (France); Ludwig Boltzmann Institute for Urban Ethology (Austria); Thales Communications (Italy).
See also: http://www.vanaheim-project.eu/
Abstract: The aim of this project is to study innovative surveillance components for the autonomous monitoring of multi-Sensory and networked Infrastructure such as underground transportation environment.

8.2.1.3. SUPPORT

Title: Security UPgrade for PORTs
Type: COOPERATION (SECURITE)
Instrument: IP
Duration: July 2010 - June 2014
Coordinator: BMT Group (UK)
Others partners: INRIA Sophia-Antipolis (FR); Swedish Defence Research Agency (SE); Securitas (SE); Technical Research Centre of Finland (FI); MARLO (NO); INLECOM Systems (UK).
Abstract: SUPPORT is addressing potential threats on passenger life and the potential for crippling economic damage arising from intentional unlawful attacks on port facilities, by engaging representative stakeholders to guide the development of next generation solutions for upgraded preventive and remedial security capabilities in European ports. The overall benefit will be the secure and efficient operation of European ports enabling uninterrupted flows of cargos and passengers while suppressing attacks on high value port facilities, illegal immigration and trafficking of drugs, weapons and illicit substances all in line with the efforts of FRONTEX and EU member states.

8.2.1.4. Dem@Care

Title: Dementia Ambient Care: Multi-Sensing Monitoring for Intelligent Remote Management and Decision Support
Type: COOPERATION (ICT)
Defi: Cognitive Systems and Robotics
Instrument: Collaborative Project (CP)
Duration: November 2011-November 2015
Coordinator: Centre for Research and Technology Hellas (G)
Others partners: INRIA Sophia-Antipolis (FR); University of Bordeaux 1 (FR); Cassidian (FR), Nice Hospital (FR), LinkCareServices (FR), Lulea Tekniska Universitet (SE); Dublin City University (IE); IBM Israel (IL); Philips (NL); Vistek ISRA Vision (TR).
Abstract: The objective of Dem@Care is the development of a complete system providing personal health services to persons with dementia, as well as medical professionals, by using a multitude of sensors, for context-aware, multiparametric monitoring of lifestyle, ambient environment, and health parameters. Multisensor data analysis, combined with intelligent decision making mechanisms, will allow an accurate representation of the person’s current status and will provide the appropriate feedback, both to the person and the associated medical professionals. Multi-parametric monitoring of daily activities, lifestyle, behaviour, in combination with medical data, can provide clinicians with a comprehensive image of the person’s condition and its progression, without their being physically present, allowing remote care of their condition.

8.2.2. Collaborations in European Programs, except FP7

8.2.2.1. ViCoMo

Program: ITEA 2
Project acronym: ViCoMo
Project title: Visual Context Modeling
Duration: October 2009 - October 2012
Coordinator: International Consortium (Philips, Acciona, Thales, CycloMedia, VDG Security)
Other partners: TU Eindhoven; University of Catalonia; Free University of Brussels; INRIA; CEA List;
Abstract: The ViCoMo project is focusing on the construction of realistic context models to improve the decision making of complex vision systems and to produce a faithful and meaningful behavior. ViCoMo goal is to find the context of events that are captured by the cameras or image sensors, and to model this context such that reliable reasoning about an event can be performed.

8.3. International Initiatives

8.3.1. INRIA International Partners

8.3.1.1. Collaborations with Asia

Pulsar has been cooperating with the Multimedia Research Center in Hanoi MICA on semantics extraction from multimedia data. Pulsar also collaborate with the National Cheng Kung University in Taiwan and I2R in Singapore.
8.3.1.2. **Collaboration with U.S.**

Pulsar collaborates with the University of Southern California.

8.3.1.3. **Collaboration with Europe**

Pulsar collaborates with Multitel in Belgium and the University of Kingston upon Thames UK.

8.3.2. **Visits of International Scientists**

8.3.2.1. **Internships**

This year Pulsar has hosted seven international internships (see section 1).

8.3.3. **Participation In International Programs**

8.3.3.1. **EIT ICT Labs**

EIT ICT Labs is one of the first three Knowledge and Innovation Communities (KICs) selected by the European Institute of Innovation & Technology (EIT) to accelerate innovation in Europe. EIT is a new independent community body set up to address Europe’s innovation gap. It aims to rapidly emerge as a key driver of EU’s sustainable growth and competitiveness through the stimulation of world-leading innovation. Among the partners, there are strong technical universities (U Berlin, 3TU / NRIICT, Aalto University, UPMC - Université Pierre et Marie Curie, Université Paris-Sud 11, Institut Telecom, The Royal Institute of Technology); excellent research centres (DFKI, INRIA, Novay, VTT, SICS) and leading companies (Deutsche Telekom Laboratories, SAP, Siemens, Philips, Nokia, Alcatel-Lucent, France Telecom, Ericsson). This project is largely described at [http://eit.ictlabs.eu](http://eit.ictlabs.eu).

We are involved in the EIT ICT Labs - Health and Wellbeing.
7. Partnerships and Cooperations

7.1. Bilateral Collaborations

7.1.1. France-USA

Participants: Gaurav Chaurasia, Pierre-Yves Laffont, Adrien Bousseau, Carles Bosch, George Drettakis, Peter Vangorp.

We have an ongoing collaboration (C. Bosch) with Yale University (Holly Rushmeier and Julie Dorsey), on weathering, resulting in the publication [12]. We continue this collaboration of fracture-related weathering.

We have an ongoing collaboration with Adobe Research (Sylvain Paris) and Fredo Durand (MIT) on intrinsic images for multiple lighting conditions. In this context Pierre-Yves Laffont visited MIT this summer July 6 - September 2.

We also collaborate with M. Banks, R. Ramamoorthi and M. Agrawala from the University of California, Berkeley in the context of our CRISP associate team, resulting in the publication [23].

7.1.2. France-Switzerland

Participants: Gaurav Chaurasia, George Drettakis.

We collaborate with O. Sorkine at ETH Zurich on image-based rendering, which resulted in the publication [16].

7.1.3. France-Germany

Participants: Peter Vangorp, George Drettakis.

We collaborate with the Justus-Liebig-University Giessen, Germany on perception techniques for rendering, notably with R. Fleming. This resulted in the following publication [20]. P. Vangorp is now a postdoctoral researcher there and this collaboration continues.

7.1.4. France-Spain

Participants: Pierre-Yves Laffont, Carles Bosch, George Drettakis.

We collaborate with C. Bosch who is now at the University of Girona (Spain), on weathering and normal mapping.

7.1.5. France-Canada

Participant: Adrien Bousseau.

We collaborate with K. Singh (University of Toronto) and Alla Schaeffer (U. British Columbia, Vancouver), on sketching techniques for materials.

7.1.6. France-Belgium

Participant: George Drettakis.

We have continued the collaboration with A. Lagae and P. Dutré and the Catholic University of Leuven, resulting in the publications [19], [18].
7.2. Visiting Researchers

We hosted several researchers this year:

- Toshiya Hachisuka (Univ. of California San Diego), in February
- Alla Sheffer (Univ. of British Columbia), in March
- Ares Lagae (KU Leuven, FWO Belgium), in March, June, and November
- Martin Banks (Univ. Of Berkeley), in April and October
- Bernd Froehlich (Bauhaus-Universitaet Weimar), in May
- Olga Sorkine (New York Univ.), in May
- Eugene Fiume (Univ. of Toronto), in June
- Christian Lessig (Univ. of Toronto), in June
- James O’Shea (Univ. of Berkeley), in July
- J.P. Lewis (Weta Digital, Wellington, NZ) in October
- Maria Roussou (Makebelieve, Greece), in November
- Carles Bosch (Univ. of Girona), in November
- Insu Yu (UCL London), in November
- Cloud Shao (Univ. of Toronto) in Nov/Dec.

7.3. International Initiatives

7.3.1. INRIA Associate Teams

7.3.1.1. CRISP

Title: Human Perception
INRIA principal investigator: George Drettakis
International Partner:

Institution: University of California Berkeley (United States)
Laboratory: Electrical Engineering and Computer Science

Duration: 2011 - 2013
See also: http://www-sop.inria.fr/reves/crisp/

The goal of the CRISP associate team between REVES and University of California (UC) Berkeley is to investigate novel ways to create, render and interact with images based on the study of human Perception. This novel and emerging area has been the focus of ongoing collaborations between researchers from the REVES research group at INRIA (Adrien Bousseau, George Drettakis) and researchers in Computer Science and Vision Science at UC Berkeley (Maneesh Agrawala, Ravi Ramamoorthi, Martin S. Banks (Human Vision Science)). All of the researchers involved in CRISP share a common interest in creating and manipulating effective synthetic imagery. To achieve this goal we will focus on understanding how people perceive complex material, lighting and shape, on developing new rendering algorithms based on this understanding, and on building interactive tools that enable users to efficiently specify the kind of image they wish to create. More specifically, we will explore the following research directions: Perception: Images are generated from the interaction of lighting, material, and geometry. We will evaluate how people perceive material, lighting, and geometry in realistic images such as photographs, and non realistic images such as drawings and paintings. This knowledge of human perception is essential for developing efficient rendering algorithms and interaction tools that focus on the most important perceptual
features of an image. We have started several projects on the perception of materials in realistic and non realistic images, with promising results. Rendering: We will develop rendering algorithms that generate images that are plausible with respect to the user’s intent and allocate resources on the visual effects that best contribute to perception. Current projects on rendering include work on enhancing material variations in realistic and non realistic rendering. Interaction: We will facilitate the creation of material, lighting, and geometric effects in synthetic images by developing novel user interfaces for novice and professional users. We are currently working on interfaces to draw object appearance and to relight photographs. Our contributions have the potential to benefit different applications of image creation such as illustration (archeology, architecture, education); entertainment (video games, movies) and design (sketching, photograph editing). This research naturally falls in INRIA’s strategic objective of interacting with real and virtual worlds.
Sémagramme Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. DiaRaFor

DiaRaFor, *Dialogues, rationalités et formalismes. Études croisées logique / psychologie / épistémologie* is a MSH-Lorraine project.

Schizophrenia is well-known among mental illnesses for the strength of the thought disorders it involves, and for their widespread and spectacular manifestations: from deviant social behavior to delusion, not to speak about affective and sensitive distortions. In the present paper we expose the first steps of a scientific research about one specific manifestation, namely disorders in conversational speech. This is an interdisciplinary research, both empirical and theoretical from several domains, namely psychology, philosophy, linguistic and informatics.

Maxime Amblard is involved in this project which ended in 2011. A new application on this topic is send in 2011 to the MSH with Maxime Amblard as leader: SLAM - Schizophrenia and Language: Analysis and Modeling.
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR DEMOTIS (Feb. 2009 - Feb. 2012)

Partners: SopinSpace (coordinator), INRIA (SMIS, SECRET), CECOGI
SMIS funding: 85k€
http://www.demotis.org/

The design and implementation of large-scale infrastructure for sensitive and critical data (e.g., electronic health records) have to face a tangle of legal provisions, technical standards, and societal concerns and expectations. DEMOTIS project aims to understand how the intricacy between legal and technical domains constrains the design of such data infrastructures. DEMOTIS consists of two interdependent facets: legal (health law, privacy law, intellectual property law) and computer science (database security, cryptographic techniques). Combining expertise of researchers in Law and computer scientists should help to better assess whether law statements can be actually put in practice, to characterize the related technological challenges when mismatches are detected and, when possible, to suggest preliminary solutions.

8.1.2. ANR KISS (Dec. 2011 - Dec. 2015)

Partners: INRIA-SMIS (coordinator), INRIA-SECRET, LIRIS, Univ. of Versailles, CryptoExperts, Gemalto, Yvelines district
SMIS funding: 230k€

The idea promoted in KISS is to embed, in trusted devices, software components capable of acquiring, storing and managing securely various forms of personal data (e.g., salary forms, invoices, banking statements, geolocation data, depending on the applications). These software components form a Personal Data Server which can remain under the holder’s control. The scientific challenges include: embedded data management issues tackling regular, streaming and spatio-temporal data (e.g., geolocation data), data provenance-based privacy models, crypto-protected distributed protocols to implement private communications and secure global computations.

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7

Program: Danish Council for Independent Research (FTP call)
Project acronym: CLyDE
Project title: Cross-LaYer optimized Database Engine
Duration: 10/2011 - 10/2014
Coordinator: Philippe Bonnet (ITU of Copenhagen)
Other partners: IT University of Copenhagen - Denmark

Abstract: The goal is to explore how flash devices, operating system and database system can be designed together to improve overall performance. Such a co-design is particularly important for the next generation database appliances, or cloud-based relational database systems for which well-suited flash components must be specified. More generally, our goal is to influence the evolution of flash devices and commodity database systems for the benefit of data intensive applications. The project should result in two complementary open-source software systems: (i) a bimodal flash device software component based on the idea from [19], and (ii) a database system optimized for bimodal flash devices. The project funding will be managed by the IT University of Copenhagen and will cover the expenses for two co-supervised PhD students (including regular visits to and from Denmark).
The SMIS members have developed tight european cooperations with the following persons/teams:

- P.M.G. Apers (Professor at the University of Twente, The Netherlands): collaboration on data confidentiality issues.

- Michalis Vazirgiannis (Athens University of Economics and Business): collaboration on Minimal Exposure in the context of Michalis’ Digiteo Chair at LIX (Ecole Polytechnique).

- P. Bonnet (Associate Professor at the University of Copenhagen, Denmark): collaboration on Flash-based data management for high-end servers. The study of flash devices started during a short sabbatical of Luc Bouganim (from April to August 2008) in Copenhagen. The uFLIP study has been conducted in close cooperation with Philippe Bonnet from IT University of Copenhagen and Björn Pór Jónsson from Reykjavík University. The cooperation with Copenhagen is very active and led to the second study on bimodal flash devices. A masters student has started a PhD thesis, co-supervised by Luc Bouganim and Philippe Bonnet on bimodal flash devices. Philippe Bonnet has planned a 1 year visit to SMIS in 2012-2013.

### 8.3. International Initiatives

The SMIS members have developed tight international cooperations with the following persons/teams:

- Dennis Shasha (Professor at the University of New-York, USA): collaboration on tamper-resistant data management issues. Dennis Shasha has done a one year sabbatical stay in SMIS (July 2006 to June 2007).

- Xiaofeng Meng (Professor at Renmin University, Beijing, China): collaboration on embedded data management issues, partly funded by a Franco-Chinese research program (PRA SI-05604).

- I. Ray and I.Ray (Professors at Colorado State University, USA): collaboration on data privacy and usage control (Indrajit and Indrakshi Ray have visited SMIS from September 2009 up to February 2010).
TALARIS Project-Team

7. Partnerships and Cooperations

7.1. McFIID

Program: CPER MISN/TALC
Project acronym: McFIID
Project title: Clustering; Statistical Analysis; Textual data; Time-evolving data; Distributed data
Duration: 2007-01-01 / 2011-12-31
Coordinator: Jean-Charles Lamirel
Other partners: INIST
Abstract: The McFIID project is a CPER project continuing the CPER CLASSIF project. It concerns the development of incremental multi-clustering techniques for managing distributed and evolving flows of textual data. New approach of diachronic analysis based on the use of multiple viewpoints combined with unsupervised bayesian reasoning, as well as new online incremental clustering techniques based on non standard similarity measures, are tested in the curse of these project.

7.2. National Initiatives

7.2.1. CCCP-Prosodie

Program: ANR CONTINT
Project acronym: CCCP Prosodie
Project title:
Duration: 2008-01-12 / 2011-31-06
Coordinator:
Other partners: Institut Télécom, UTC Compiégne, UNSA (Univ. Nice Sophia-Antipolis), Univ. de Versailles St-Quentin
Abstract: The goal of CCCP-Prosodie is to empirically investigate the functioning of online communities such as Wikipedia, and particular to link their activities and their use of language (as recorded in such corpora as email exchanges, for example). The TALARIS team is involved in this project for three reasons: to provide Natural language processing tools, to design an annotation scheme capable of dealing with information from both the social sciences (sociology and economics) and the humanities (psychology and ergonomics), and to provide help with inference technology.
See also: http://recherche.telecom-bretagne.eu/labo_communicant/cccp-prosodie/

7.2.2. PORT-MEDIA

Program: ANR CONTINT
Project acronym: PORT-MEDIA
Project title:
Duration: 2009-03-01 / 2012-03-01
Coordinator:
Other partners: ELDA, LIG/GETALP, LIA, LIUM, LORIA
Abstract: The PORT-MEDIA project is an ANR project that aims to collect linguistic data for multiple domains and to investigate the use of a high-level semantic representation for annotating dialogue corpora. TALARIS contributed to the high-level semantics specification for annotating the MEDIA corpus and to the development of tools for the manual annotation (e.g., ATOOL and SRL-Web Annotation) as well as to the development of the blackboard architecture for the automatic annotation of the MEDIA corpus. Additionnally, Talaris provided the automatic annotation of the whole corpus and its evaluation.

See also: http://www.port-media.org/doku.php?id=start

7.2.3. SYFRAP

Program: PEPS INS2I-INSHS
Project acronym: SYFRAP
Project title: Analyse syntaxique du français parlé
Duration: 2011-06-01 / 2013-06-01
Coordinator: Claire Gardent, LORIA
Other partners: ATILF Nancy, LLF Paris 7

Abstract: SYFRA is a exploratory interdisciplinary project (PEPS INS2I-INSHS) funded by the CNRS. It gathers researchers from LORIA (Nancy), LLF (Paris 7) and from ATILF (Nancy); and aims to develop resources (annotated corpora) and tools for the syntactic analysis of spoken French.

See also: http://talc.loria.fr/-SYFRAP,71-.html

7.3. Collaborations in European Programs, except FP7

7.3.1. Allegro

Program: INTERREG IV A
Project acronym: Allegro
Project title:
Duration: 01.2010 - 12.2012
Coordinator: U. Saarbrücken (Germany)
Other partners: Supelec Metz, INRIA Nancy Grand Est

Abstract: The Allegro project aims to develop NLP techniques that support language teaching for French and German.

7.3.2. Emospeech

Program: Eurostars
Project acronym: Emospeech
Project title:
Duration: 2010-09-01 / 2013-08-31
Coordinator: Artefacto, Rennes
Other partners: Acapella, INRIA Nancy Grand Est

Abstract: The EMOSPEECH project aims to augment serious games with natural language (spoken and written dialog) and emotional abilities (gesture, intonation, facial expressions).

7.3.3. Metaverse
Program: ITEA2

Project acronym: Metaverse

Project title:

Duration: 2009-01-01 / 2011-04-31

Coordinator:

Other partners: Belgian partners: Alcatel-Lucent Bell N.V., Nazooka, IBBT-SMIT; French partners: Alcatel-Lucent France, Orange Labs, CEA List, Artefacto; Greek partners: Forthnew S.A., Ellinoger-maniki Agogi; Dutch partners: Philips Research, Philips I-Lab, DevLab, Technical University Eindhoven, University of Twente, Stg. EPN, VU Economics & BA, VU CAMeRA; Spanish partners: Innovalia, Ceeda, VirtualWare, CBT, Nextel, Corsa, Avantalia, I&IMS, VicomTECH, E-PYME, CIC Tour Game, UPF-MTH; Israeli partners: Metaverse Labs.

Abstract: Metaverse is an exciting project whose goal is to provide a standardized global framework enabling the interoperability between virtual worlds (for example Second Life, World of Warcraft, IMVU, Active Worlds, Google Earth and many others) and the Real world (sensors, actuators, vision and rendering, social and welfare systems, banking, insurance, travel, real estate and many others).

7.4. International Initiatives

7.4.1. INRIA Associate Teams

7.4.1.1. INTOHYLO

Title: Inference Tools for Hybrid Logics and Applications for Natural Language Processing

INRIA principal investigator: Carlos Areces

International Partner:

Institution: Universidad de Buenos Aires (Argentina)

Laboratory: Universidad de Buenos Aires, GLyC

Duration: 2009 - 2011

See also: http://led.loria.fr/dokuwiki/doku.php?id=intohylo--inria_equipes_associees

The main aim of the InToHyLo project is to investigate inference methods for hybrid logics, to develop highly optimized inference tools based on these methods, and to use these tools in natural language applications. Talaris and GLyC are currently leaders in automated theorem proving for hybrid logics, and they are the developers of the two provers HyLoRes (based on resolution) and HTab (based on tableaux). With the InToHyLo project we want to investigate how to combine resolution and tableaux algorithms to allow our provers to collaborate and share partial results. We will integrate our tools in a platform suitable for inference in NLP applications (focusing on Dialogue Systems and Textual Entailment). This platform will include not only tools for satisfiability testing, but also for model building, model checking, bisimulation checking, and knowledge maintenance and retrieval. Finally, we want to develop parallel inference algorithms to improve performance, and distributed testing to speed up developing.

7.4.2. Visits of International Scientists

- Kristina Striegnitz, Union College, Schenectady, NY, 1 week in January 2011
- Eva Banik, Computational Linguistics Ltd, 1 week in May 2011
7.4.3. Participation In International Programs

7.4.3.1. GIVE challenge organisation

Talaris co-organized the 2.5 edition of the Generation of Instructions in Virtual Environment challenge. This challenge brought together six universities or laboratories working on natural language generation: University of Aberdeen, University of Bremen, University of Cordoba, University of Postdam, University of Twente, and the LORIA. The challenge was available online for players to test the different systems. Eight systems were participating in the campaign. Over two months, we collected 536 games, which is lower than last year. We assume that the summer break which coincided with the challenge played a role. Our participation in the organisation of the campaign involved rewriting the network layer, a complete change of the visibility algorithm, and advertising the challenge.
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR-PERSEE

**Participants:** Josselin Gauthier, Christine Guillemot, Laurent Guillo, Olivier Le Meur.

- **Title:** Perceptual coding for 2D and 3D images.
- **Research axis:** § 6.1.2, 6.1.3.
- **Partners:** IRCCYN-Polytech Nantes, INSA-Rennes, Telecom Paris Tech.
- **Funding:** ANR.
- **Period:** 10/2009-09/2012

The objective of the project is to develop perceptually driven coding solutions for mono-view and multi-view video. TEMICS contributes on different problems relevant for mono-view and multi-view video coding: visual attention modeling (see Section 6.1.3), on texture synthesis and inpainting for both 2D and 3D content. Several methods for 2D image inpainting and 2D/3D inpainting to handle disocclusions in virtual view synthesis have been developed (see Sections 6.1.2. A computational model for 3D content has also been studied (see Section 6.1.3).

8.1.2. ANR-TCHATER

**Participant:** Jean-Jacques Fuchs.

The RNRT project TCHATER (Terminal Coherent Hétérodyne Adaptatif TEmps Reel) whose coordinator is Alcatel has started in January 2008. Its aim is to fully implement coherent detection in an optical fibers transmission systems, with among others the real time implementation on dedicated FPGAs. TEMICS has collaborated with ASPI on the design of solutions to adapt the extremely high channel rate, 4 ADC (analog-to-digital converters) and to accommodate the FPGA to the output rate, as well as temporal multiplexing of order 40. The project ended successfully in June 2011 with an operational prototype consisting in 4 analog-to-digital converters followed by 4 (Stratix IV) FPGAs implementing in real time the Chromatic Dispersion annihilating filters, the Constant Modulus Algorithm thau equalizes the channel, the Carrier Frequency Estimators and the Carrier Phase Estimators.

8.1.3. ANR-ARSSO

**Participants:** Mounira Ebdelli, Christine Guillemot, Laurent Guillo, Aline Roumy.

- **Title:** Adaptable, Robust, Streaming SOlutions.
- **Partners:** INRIA/Planète, TESA-ISAE, CEA-LETI/LNCA, ALCATEL LUCENT BELL LABS, THALES Communications, EUTELSAT SA.
- **Funding:** ANR.
- **Period:** 06/2010-11/2013

The ARSSO project focuses on multimedia content communication systems, characterized by more or less strict real-time communication constraints, within highly heterogeneous networks, and toward terminals potentially heterogeneous too. It follows that the transmission quality can largely differ in time and space. The solutions considered by the ARSSO project must therefore integrate robustness and dynamic adaptation mechanisms to cope with these features. The overall goal is to provide new algorithms, develop new streaming solutions and study their performances. TEMICS contributes on the development and improvement of scalable video coding techniques and components to make the video codec robust to losses. More specifically loss concealments methods will be developed.
8.2. European Initiatives

8.2.1. IST-NEWCOM++

**Participants:** Christine Guillemot, Aline Roumy.

Program: VII Framework Program, Objective ICT-2007.1.1
Project acronym: IST-NEWCOM++
Coordinator: Politecnico Di Torino
Other partners: 17 partners across Europe

Abstract:

The NEWCOM++ project proposal (Network of Excellence in Wireless COMMunication) intends to create a trans-European virtual research centre on the topic “The Network of the Future”. It was submitted to Call 1 of the VII Framework Program under the Objective ICT-2007.1.1: The Network of the Future, mainly in its target direction “Ubiquitous network infrastructure and architectures”. We participate in the workpackage WPR7 - Joint source and channel co-decoding which we coordinate together with the task TR7.3 Tools for multi-terminal JS/CC/D. WPR7 addresses issues related to the robust transmission of multimedia, and essentially video, over wireless channels (possibly terminating a wired IP network). In this framework, we proposed a novel distributed compressed sensing algorithm (see Section ADD REF for details) in collaboration with E. Magli and G. Coluccia (Politecnico di Torino). A paper has been published at the EUSIPCO 2011 conference and awarded the 2011 Best Paper Award “Francesco Carassa”.
TEXMEX Project-Team

8. Partnerships and Cooperations

8.1. National initiatives

8.1.1. ANR Attelage de systèmes hétérogènes

Participants: Guillaume Gravier, Bogdan Ludusan.

Duration: 3 years, started in November 2009.

Partners: IRISA, LIA, LIUM

The project ASH (Automatic System Harnessing) aims at developing new collaborative paradigms for speech recognition. Many current ASR systems rely on an a posteriori combination of the output of several systems (e.g., confusion network combination). In the ASH project, we investigate new approaches in which three ASR systems work in parallel, exchanging information at every step of the recognition process rather than limiting ourselves to an a posteriori combination. What information is to be shared and how to share such information and make use of it are the key questions that the project is addressing. The collaborative paradigm is being extended to landmark-based speech recognition where detection of landmarks and speech transcription can be considered as two (or more) collaborative processes.

8.2. International initiatives

8.2.1. Visits of international scientists

8.2.1.1. Visit to Delft University of Technology

Participant: Guillaume Gravier.

Guillaume Gravier was invited to the Multimedia Information Retrieval Lab at Delft University of Technology for one week in May 2011. He gave a seminar entitled Speech, Language and Multimedia at IRISA/INRIA Rennes and participated in the organization of MediaEval 2011, an international benchmark initiative in multimedia processing. A EU project involving TU Delft and IRISA/INRIA Rennes, initiated during his visit in Delft, has been submitted to the FET Open program.

8.2.1.2. Visit to the BUSIM speech processing group at Bogazici University

Participant: Julien Fayolle.

Julien Fayolle spent three months, from May to July 2011, in the BUSIM speech processing group at Bogazici University (Istanbul, Turkey) to work on lexical-phonetic automata for spoken utterance retrieval in collaboration with Murat Saraclar. Whereas the state-of-the-art approaches consist in a late fusion of the results of phonetic and lexical searches, the idea was to adapt the Murat Saraclar’s spoken utterance retrieval methods to a new representation combining both lexical and phonetic levels earlier than the retrieval step.

8.2.1.3. Doctoral Internship from Florida State University

Participants: Guillaume Gravier, Patrick Gros, Hervé Jégou.

Jiangbo Yuan spent five months in the TExMEX project-team to work on audio indexing for video copy detection. He has contributed to the submission of INRIA at copy detection task, working on our audio indexing engine, more precisely on the post-verification step. He then worked on the detection of near-duplicate patterns in very large datasets of vectors.

His venue was funded by the EIT ICT Labs OpenSEM project.

8.2.1.4. Visit to the Czech Technical University in Prague

Participant: Hervé Jégou.
Hervé Jégou spent one week (October 2011) in the Center of Machine Perception at the Czech Technical University, Prague, to initiate a collaboration with Pr. Jiri Matas and Dr. Ondrej Chum. During this visit, he gave an invited talk at the 29th Pattern Recognition and Computer Vision Colloquium, entitled “Approximate search as a source coding problem, with application to large scale image retrieval”. This visit was the opportunity to start a joined work on image search.

8.2.1.5. Visit of members of the University of Reykjavík and Videntifier Technologies

Participant: Laurent Amsaleg.

Björn Þór Jónsson from the School of Computer Science, Reykjavík University, Iceland and with Herwig Lejsek, Videntifier Technologies, Iceland spent one week in the team. They came to participate to the large scale high dimensional indexing experiments involving more than 30 billion SIFT descriptors.
7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. EMOA project

Participants: Georges Dumont [contact], Zhaoguang Wang.

EMOA project [2007-mid2011] of the competitiveness cluster ID4CAR is funded by The french ministry of industry. This project involves seven industrial partners (PSA as project manager, ARCELOR, CETIM, ESI Group, Gruau, Cerizay, E. Leclerc) and five academic partners (CROMEP, UBS, ENS Cachan, IrCCyN, IRISA-ENS Cachan). The goal of this project is to improve the quality of stamped parts of car bodies. We are involved in the work package 11 with the purpose of proposing quality validation methods based on virtual reality project reviews. This could allow the industrial partners to verify and to improve the stamping tools design. The aim of Zhaoguang Wang PHD thesis [3] was to propose models and simulation methods for computation of the parts deformation in interactive time compatible with haptic manipulation by the user. This method is based on modal analysis and mode recombination.

7.1.2. FUI SIFORAS

Participants: Valérie Gouranton [contact], Bruno Arnaldi [contact].

SIFORAS (Simulation for training and assistance), based on GVT 5.2, aims to propose Instructional Systems Design to answer the new objectives of training (Intelligent Tutorial System, mobility, augmented reality, high productivity).

SIFORAS involves Academic partners 4 (INSA Rennes, ENIB, CEA-List, ENISE) and 9 Industrial partners (Nexter Training, Delta CAD, Virtualys, DAF Conseils, Nexter Systems, DCNS, Renault, SNCF, Alstom).

In this project, INSA Rennes-VR4i aims ensuring consistency with respect to CORVETTE project (see section 7.1.4) in particular for the global architecture based on STORM and LORA models.

7.1.3. ANR Collaviz

Participants: Thierry Duval [contact], Valérie Gouranton [contact], Cédric Fleury, Laurent Aguerreche.

Collaviz is an innovative multi-domain remote collaborative platform (project ANR-08-COSI-003-11 funded by the french national research agency) for the simulation-based design applications.

Collaviz involves 6 Academic partners (ECP, EGID, INPT, INSA Rennes, LIRIS, Scilab) and 11 Industrial partners (Artenum, BRGM, Distene, EDF, Faurecia, Medit, MCLP Consulting, NECS, Oxalaya, TechViz, Teratec)

The major value brought by Collaviz to the scientific and industrial community is to make remote analysis and collaboration easily available and scalable. Web-based technologies, on the top of shared high-performance computing and visualization centers, will permit researchers and engineers handling very large data sets, including 3D data models, by using a single workstation, wherever in the world. Just a "standard" internet connection will be needed. The classical approach is not adapted anymore: simulation-based design applications tend to generate Terabytes and even Petabytes of data.

We are leading the WP4 about Collaborative Virtual Environments and Techniques, whose aim is to manage the 3D collaborative interactions of the users. During 2011 we contributed to the second Collaviz prototype by providing the final version of a collaboration service, and by building upon it new collaborative interaction metaphors. We also improved the Collaviz software architecture in order to provide interoperability, making it possible to share a virtual universe between heterogeneous 3D viewers.
Scientific contributions are presented in [17], [16].

We have also deployed the Collaviz framework between London (in the immersive room of the University College of London) and Rennes (in our Immersia room). We setup an experiment of collaborative manipulation of a clipping plane inside 3D scientific data within VISIONAIR project. This first real deployment of Collaviz is a success, it has allowed efficient co-manipulation of a shared 3D object between two really distant users.

7.1.4. ANR Corvette

Participants: Bruno Arnaldi [contact], Valérie Gouranton [contact], Florian Nouviale, Andrès Saraos-Luna.

Corvette (COllaboRative Virtual Environment Technical Training and Experiment) aims to propose a set of scientific innovations in industrial training domain (maintenance, complex procedures, security, diagnostic, ...) exploiting virtual reality technologies. This project has several scientific axes: collaborative work, virtual human, communication and evaluation.

Corvette involves 3 Academic partners (INSA Rennes, ENIB, CEA-List) and 3 Industrial partners (Nexter Training, Virtualys, Golaem). We (INSA Rennes) are leading the ANR Corvette.

The project seeks to put in synergy a number of scientific axes:

- Collaborative work that can handle representative complex scenarios of industrial training
- Virtual Human for its ability to embody the user as an avatar and acting as a collaborator during training
- Natural communication between users and virtual humans for task-oriented dialogues
- Methodology in cognitive psychology for the assessment of the effectiveness of the collaboration of users and virtual humans to perform complex cooperative tasks in a virtual environment.

Some directions are emerging to address the projects goals. We define the specifications to achieve the creation of our new architecture for training applications. We also study the states of the art in the fields: collaborative work, virtual human, communication, scenarios. We specify the two industrial scenarios of the project. We propose an architecture that permits the solutions of the main breakthroughs to be integrated.


7.1.5. ANR Acoustic

Participant: Maud Marchal [contact].

The main objective of the project ACouStiC is to develop an innovative strategy based on models for helping decision-making process during surgical planning in Deep Brain Stimulation. Models rely on different levels involved in the decision-making process; namely multimodal images, information, and knowledge. The project aims at developing methods for 1) building generic and patient specific models and 2) automatically computing optimal electrodes trajectories from these models taking into account possible simulated deformations occurring during surgery. VR4i is involved in the project with Shaman INRIA project-team and aims at providing models of deformations of the cerebral structures and electrodes for the surgical planning. The objective is to propose a biomechanical approach to model the brain and electrode deformations and also their mutual interaction.

7.1.6. ANR Open-ViBE2

Participants: Laurent Bonnet, Alain Chauffaut, Thierry Duval, Laurent George, Anatole Lécuyer [contact], Jozef Legény.

OpenViBE2 is a 3-year project funded by the French National Agency for Research. The objective of OpenViBE2 is to propose a radical shift of perspective about the use of Brain-Computer Interfaces (BCI). First, in OpenViBE2 we consider the possibility to merge a BCI with traditional peripherals such as joysticks, mice and other devices, all being possibly used simultaneously in a virtual environment. Therefore, BCI is not seen as a replacement but as a complement of classical HCI. Second, we aim at monitoring brain cognitive functions and mental states of the user in order to adapt, in real-time and in an automated fashion, the interaction protocol as well as the content of the remote/virtual environment (VE).
One major strength of OpenViBE2 consortium relies on the fact that four partners were already involved in the previous ANR project OpenViBE1 (2005-2009): INRIA, INSERM, GIPSA-LAB, CEA. In addition, six partners have joined OpenViBE2 to bring their complementary expertise required by the scope of our proposal: CHART, CLARTE, UBISOFT, BLACK SHEEP, and KYLOTONN.

In parallel, the OpenViBE2 consortium contributes to the free and open-source software OpenViBE, which is devoted to the design, test and use of Brain-Computer Interfaces (see Section 5.3).

7.1.7. BRAINVOX

Participants: Anatole Lécuyer [contact], Jozef Legény [contact].

The BRAINVOX project is a project funded by Brittany region in the frame of the CREATE call. It is a 4 year-project (2008-2012), on the topic of Brain-Computer Interfaces.

The "blue-sky" vision of the BrainVox project is a "mental language", more elaborated, and richer, for BCI applications. We want to study the possibility for a single user to exploit various mental activities, in order to achieve more varied operations in the BCI-based application within novel hybrid BCI schemes. In the end, this novel mental language would enable a practice of BCI richer and more intuitive, with more potential actions in the real world. This should improve the spreading of BCI technologies in numerous applications such as multimedia and video games, but also assistance to disabled people.

7.1.8. NIEVE

Participant: Anatole Lécuyer [contact].

The collaborative research initiative (ARC) NIEVE aims at:

- Studying the modulation of emotion in audiovisual VEs, focusing on the case of phobia of dogs in the iCube.
- Studying appropriate representations, view combinations/ transitions and auditory feedback for effective navigation in VEs
- Developing novel immersive audiovisual interfaces for navigation in VEs
- Developing an innovative emotion-based methodology for the evaluation of immersive navigation interfaces.

This research initiative involves two INRIA teams, REVES and VR4i, and IRCAM. It is supported by DREAM service at INRIA Sophia-Antipolis.

7.1.9. ADT Loic

Participants: Anatole Lécuyer [contact].

This ADT is a collaboration on OpenViBE software between two INRIA teams: VR4i team at INRIA Rennes and Cortex team at INRIA Nancy.

7.2. European Initiatives

7.2.1. INFRA-FP7: VISIONAIR

Participants: Georges Dumont [contact], Bruno Arnaldi, Valérie Gouranton, Thierry Duval, Alain Chauffaut, Ronan Gaugne.
Our actual Virtual Reality systems allowed us to be a key partner within the European Project VISIONAIR (http://www.infra-visionair.eu/) that began in February 2011 in the infrastructure call of FP7. Our Immersia (see section 6.4) Virtual Reality room is now, in Europe, a key place for virtual reality. We are leading the Work Package 9 on Advanced methods for interaction and collaboration of this project and are deeply involved in the directory board and in the scientific piloting committee. The VISIONAIR project’s goal is to create a European infrastructure that should be a unique, visible and attractive entry towards high level visualization facilities. These facilities will be open to the access of a wide set of research communities. By integrating our existing facilities, we will create a world-class research infrastructure enabling to conduct frontier research. This integration will provide a significant attractiveness and visibility of the European Research Area. The partners of this project have proposed to build a common infrastructure that would grant access to high level visualization and interaction facilities and resources to researchers. Indeed, researchers from Europe and from around the world will be welcome to carry out research projects using the visualization facilities provided by the infrastructure [6]. Visibility and attractiveness will be increased by the invitation of external projects.

This project is built with the participation of 26 partners, INPG ENTREPRISE SA IESA France, Institut Polytechnique de Grenoble University, University of Patras LMS Greece, Cranfield University United Kingdom, Universität Twente Utwente Netherlands, Universität Stuttgart Germany, Instytut Chemii Bioorganicznej Pan Polska Poland, Université De La Méditerranée D’aix-Marseille II France, Consiglio Nazionale Delle Ricerche CNR Italy, Institut National de Recherche en Informatique et en Automatique INRIA France, Kungliga Tekniska Hoegskolan Sweden, Technion - Israel Institute of Technology Israel, Rheinisch-Westfaelische Technische Hochschule Aachen RWTH Germany, Poznan University of Technology Poland, Arts et Métiers ParisTech AMPT France, Technische Universität Kaiserslautern Germany, The University of Salford United Kingdom, Fraunhofer-gesellschaft zur foerderung der Angewandten Forschung Germany, Fundacio privada I2CAT Spain, University of Essex United Kingdom, Magyar Tudomanyos Akademia Szamitastechnikai Es Automatizalasi Kutato Intezet Hungary, École Centrale de Nantes France, University College of London United Kingdom, Politecnico di Milano Polimi Italy, European Manufacturing and Innovation Research Association (cluster leading excellence).

7.2.2. STREP: NIW

Participants: Gabriel Cirio, Anatole Lécuyer [contact], Maud Marchal, Léo Terziman.

The Natural Interactive Walking Project (NIW) is a 3-year project funded by the European Commission under the FET Open STREP call. NIW involves 5 partners: INRIA/VR4i (Bunraku), University of Verona (leader), University of Aalborg, University of Paris 6, and McGill University. The Natural Interactive Walking (NIW) project aims at taking advantage of multisensory information about the ground to develop knowledge for designing walking experiences. This will be accomplished through the engineering and perceptual validation of human-computer interfaces conveying virtual cues of everyday ground attributes and events. Such cues may be conveyed by auditory, haptic, pseudo-haptic, and visual augmentation of otherwise neutral grounds. The project is focused on creating efficient and scalable display methods across these modalities that can be easily and cost-effectively reproduced, via augmented floors and footwear.

It is expected that the NIW project will contribute to scientific knowledge in two key areas. First, it will reinforce the understanding of how our feet interact with surfaces on which we walk. Second, it will inform the design of such interactions, by forging links with recent advances in the haptics of direct manipulation and in locomotion in real-world environments. The methods that will be created could impact a wide range of future applications that have become prominent in recently funded research within Europe and North America. Examples include floor-based navigational aids for airports or railway stations, guidance systems for the visually impaired, augmented reality training systems for search and rescue, interactive entertainment, and physical rehabilitation.

7.2.3. ADT-Mixed Reality Technological Development: VCore

Participants: Georges Dumont [contact], Thierry Duval, Valérie Gouranton, Alain Chauffaut [contact], Ronan Gaugne [contact], Rémi Félix.
The Mixed Reality Project is a shared collaboration between Fraunhofer IGD and five INRIA research centers: Rennes, Grenoble, Sophia, Lille and Saclay. On the INRIA side, the project started in October 2011, with a four years outlook, as an ADT with two IJDs, one in Rennes and one in Sophia. The goal of the project is to build a modular shared source software framework, fostering the development of new and unique research topics and application areas, which can be used alike by research teams and innovative companies. The goal is to make it a de facto standard, favoring interoperability between various developments in the mixed reality area. Research teams will get a sound software base that helps them focus their efforts on innovative software libraries or applications. Companies will benefit from implementations of state-of-the-art algorithms as well as a full-fledged framework strongly connected with 3D-related emerging standards like Collada, X3D and WebGL.
7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Autonomy

Participants: Audrey Colbrant, Yohan Lasorsa, Jacques Lemordant, David Liodenot, Mathieu Razafimahazo.

Autonomy is a 22-month project funded by the global competitiveness cluster Minalogic (6th call for R&D projects) that started in March 2010, and is coordinated by ST Ericsson. Other partners are ST Microelectronics, Raisonance, Université de Grenoble, and Ivès.

The goal of the project is to develop high-tech tools to improve autonomy for people with disabilities. These tools are integrated in mobile devices such as cell phones or special-purpose devices, to improve the quality of life of people with disabilities. These devices access remote dedicated services to help geolocation and guiding. They take advantage of the latest advances in embedded systems: cameras, audio, video, GPS, RFID, compass, accelerometer, gyroscope. Two major application areas are addressed: software tools on cell phones for sight disabled people, and guiding and information tools for moving around in a city.

7.1.2. Grenoble Augmented City

Participants: Audrey Colbrant, Yohan Lasorsa, Jacques Lemordant, David Liodenot, Mathieu Razafimahazo.

Grenoble Augmented City is a large scale experimentation of augmented reality technologies, funded by the Rhône-Alpes Region for 12 months. Coordinated by CCSTI Grenoble, the project includes GRESEC (Stendhal University, Grenoble), the public libraries of Grenoble, the tourist office of Grenoble, and musée Dauphinois.

This project uses XML formats for multimedia content (HTML5), interactive audio (A2ML), and points of interest (W3C POI) in complex mixed reality applications. As a consequence, the authoring of a specific application is greatly simplified.

The MRB browser developed by WAM is a Mixed Reality Browser whose main features are:

- use of an XML format for Points of Interest (POI) issued from an on-going discussion within the W3C Points of Interest working group,
- use of HTML5 for the multimedia content of POIs, allowing easy authoring inside a standard HTML5 browser,
- navigation between POIs at the level of the format using MAUDL audio POIs,
- switching between Augmented Reality and Augmented Virtuality through the use of panoramic images and the concept of groups of POIs.

The MRB browser is running on the iPhone 4 and the iPad.

A cultural heritage visit of Grenoble can be downloaded from the web and played on site in Augmented Reality or remotely in Augmented Virtuality. This visit will be tested by visually impaired people.

7.2. National Initiatives

7.2.1. Codex

Codex is a project funded by ANR as part of its Emerging Domains program (DEFIS). It started in March 2009 for a duration of 36 months. WAM is working with five partners: INRIA Saclay Île-de-France (project-team Leo), INRIA Lille Nord-Europe (project-team Mostrare), University Paris Sud, Centre universitaire de Blois, and Innovimax SARL.

Codex seeks to push the frontier of XML technology innovation in three interconnected directions:

- Languages and algorithms: prototypes are developed for efficient and expressive XML processing, in particular advancing towards massively distributed XML repositories.
- Codex considers models for describing, controlling, and reacting to the dynamic behavior of XML corpora and XML schemas with time.
- The project proposes theories, models and prototypes for composing XML programs for richer interactions, and XML schemas into rich, expressive, yet formally grounded type descriptions.

7.2.2. C2M

Participants: Fabien Cazenave, Cécile Roisin.

Multimedia Cooperative Publishing Chain (C2M) is a project funded by ANR as part of its Digital Contents and Interaction program (CONTINT). It started in September 2009 for a duration of 24 months. WAM is working with five partners: Université de Technologie de Compiègne, Kelis Conseil et Développement, Amexio, Heudiasyc laboratory (CNRS), Institut National de l’Audiovisuel (INA).

The project aims at integrating XML publishing chains, Enterprise Content Management (ECM), and multimedia creation tools, in order to design a complete digital system for multimedia creation, management and publishing.

The main challenge lies in the convergence of several approaches:

- storage and management of document fragments,
- structured editing,
- maintaining and repurposing content,
- planning, cooperation and production.

Convergence is made possible by the maturity of XML technologies and by the collaborative practices popularized by the web.

7.3. European Initiatives

7.3.1. Venturi

Participants: Yohan Lasorsa, Jacques Lemordant, David Liodenot, Mathieu Razafimahazo.

immersiVe ENhancement of User-world Interactions, FP7-ICT-2011-7, STREP, duration: 36 months starting in October 2011, Partners: Fondazione Bruno Kessler (Italy), Fraunhofer Heinrich Hertz Institute (Germany), ST Microelectronics (Italy), ST-Ericsson (France), Metaio (Germany), e-Diam Interactive (Spain), Sony-Ericsson (Sweden).

Venturi aims to create a pervasive Augmented Reality paradigm, where available information will be presented in a user- rather than device-specific way. The goal is to create an experience that is always present whilst never obstructing. Venturi will exploit, optimize and extend current and next generation mobile platforms; verifying platform and QoE performance through life-enriching use cases and applications to ensure device-to-user continuity.

7.4. International Initiatives

7.4.1. INRIA International Partners

We are working with the MEDIA group at EPFL (Lausanne, Switzerland) on XML editing, more specifically on the template-driven approach.
Members of the WAM project-team participate in several activities of the World Wide Web Consortium (W3C):

- Vincent Quint is a member of the W3C Advisory Committee.
- Nabil Layaida is a member of the W3C Synchronized Multimedia working group.
- Jacques Lemordant is a member of the W3C Points of Interest Working Group.
- The Amaya web editor is developed jointly with W3C. The software is distributed by W3C.
WILLOW Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Agence Nationale de la Recherche: DETECT (ENS)

Participant: Josef Sivic.

The DETECT project aims at providing new statistical approaches for detection problems in computer vision (in particular, detecting and recognizing human actions in videos) and bioinformatics (e.g., simultaneously segmenting CGH profiles). These problems are mainly of two different statistical nature: multiple change-point detection (i.e., partitioning a sequence of observations into homogeneous contiguous segments) and multiple tests (i.e., controlling a priori the number of false positives among a large number of tests run simultaneously).

This is a collaborative effort with A. Celisse (University Lille 1), T. Mary-Huard (AgroParisTech), E. Roquain and F. Villers (University Paris 6), in addition to S. Arlot and F. Bach from INRIA SIERRA team and J. Sivic from Willow.

S. Arlot (INRIA SIERRA) is the leader of this ANR “Young researchers” project.

8.2. European Initiatives

8.2.1. QUAERO (INRIA)

Participant: Ivan Laptev.

QUAERO (AII) is a European collaborative research and development program with the goal of developing multimedia and multi-lingual indexing and management tools for professional and public applications. Quaero consortium involves 24 academic and industrial partners leaded by Technicolor (previously Thomson). Willow participates in work package 9 “Video Processing” and leads work on motion recognition and event recognition tasks.

8.2.2. EIT-ICT: Cross-linking Visual Information and Internet Resources using Mobile Networks (INRIA)

Participants: Ivan Laptev, Josef Sivic.

The goal of this project within the European EIT-ICT activity is to perform basic research in the area of semantic image and video understanding as well as efficient and reliable indexing into visual databases with a specific focus on indexing visual information captured by mobile users into Internet resources. The aim is demonstrate future applications and push innovation in the field of mobile visual search.

This is a collaborative effort with C. Schmid (INRIA Grenoble) and S. Carlsson (KTH Stockholm).

8.2.3. European Research Council (ERC) Advanced Grant

Participants: Jean Ponce, Ivan Laptev, Josef Sivic.

WILLOW will be funded in part from 2011 to 2015 by the ERC Advanced Grant "VideoWorld" awarded to Jean Ponce by the European Research Council.
This project is concerned with the automated computer analysis of video streams: Digital video is everywhere, at home, at work, and on the Internet. Yet, effective technology for organizing, retrieving, improving, and editing its content is nowhere to be found. Models for video content, interpretation and manipulation inherited from still imagery are obsolete, and new ones must be invented. With a new convergence between computer vision, machine learning, and signal processing, the time is right for such an endeavor. Concretely, we will develop novel spatio-temporal models of video content learned from training data and capturing both the local appearance and nonrigid motion of the elements—persons and their surroundings—that make up a dynamic scene. We will also develop formal models of the video interpretation process that leave behind the architectures inherited from the world of still images to capture the complex interactions between these elements, yet can be learned effectively despite the sparse annotations typical of video understanding scenarios. Finally, we will propose a unified model for video restoration and editing that builds on recent advances in sparse coding and dictionary learning, and will allow for unprecedented control of the video stream. This project addresses fundamental research issues, but its results are expected to serve as a basis for groundbreaking technological advances for applications as varied as film post-production, video archival, and smart camera phones.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Labex NUMEV, Montpellier

In the context of the Excellence Initiative of the MENRT, we are participating in the Laboratory of Excellence (labex) NUMEV (Digital and Hardware Solutions, Modelling for the Environment and Life Sciences) headed by University of Montpellier 2 in partnership with CNRS, University of Montpellier 1, and INRIA. NUMEV seeks to harmonize the approaches of hard sciences and life and environmental sciences in order to pave the way for an emerging interdisciplinary group with an international profile. The NUMEV project is decomposed in four complementary research themes: Modelling, Algorithms and computation, Scientific data (processing, integration, security), Model-Systems and measurements. Patrick Valduriez heads the theme on scientific data.

8.2. National Actions

8.2.1. ANR VERSO DataRing (2008-2012, 200Keuros)

Participants: Reza Akbarinia, Fady Draidi, Mohamed Jawad, Esther Pacitti, Guillaume Verger, Patrick Valduriez [contact].

URL: http://www-sop.inria.fr/teams/zenith/dataring

The DataRing project, headed by P. Valduriez, involves the Leo project-team (INRIA Saclay Ile de France), LIG, LIRMM and Telecom ParisTech. The objective is to address the problem of data sharing for online communities, such as social networks (e.g. sites like MySpace and Facebook) and professional communities (e.g. research communities, online technical support groups) which are becoming a major killer application of the web. The project addresses this problem by organizing community members in a peer-to-peer (P2P) network ring across distributed data source owners where each member can share data with the others through a P2P overlay network. In this project, we study the following problems: schema matching, query processing with data uncertainty, data indexing and caching, data privacy and trust. To validate our approach, we develop services based on our prototypes WebSmatch, SON, P2Prec and ProbDB.

8.2.2. ANR STAMP (2008-2011, 60Keuros)

Participants: Ayoub Ait Lahcen, Didier Parigot [contact], Guillaume Verger.


The STAMP project is with CIRAD, INRA, CNRS and U. Paris-Est. The overall objective is to overcome present limitations of dynamic landscape modeling with spatial, temporal and multi-scale primitives. Our approach is to explore new spatial and temporal primitives and the potential benefits that recent advances in meta-modeling and Model-Driven Engineering can bring into the field of landscape studies. We contribute, together with CIRAD and U. Paris-Est, to the definition of a domain-specific language, called Ocelet.
**8.3. International Initiatives**

**8.3.1. INRIA Associate Teams**

**8.3.1.1. SARAVA**

Title: Sarava: P2P data sharing for online communities  
INRIA principal investigator: Patrick Valduriez  
International Partner:  
- Institution: Federal University of Rio de Janeiro (Brazil)  
- Laboratory: Instituto Alberto Luiz Coimbra  
Duration: 2009 - 2011  
See also: [http://www-sop.inria.fr/teams/zenith/pmwiki/pmwiki.php/Sarava/Sarava](http://www-sop.inria.fr/teams/zenith/pmwiki/pmwiki.php/Sarava/Sarava)

The general problem we address in Sarava is P2P data sharing for online communities, by offering a high-level network ring across distributed data source owners. The major advantage of P2P is a completely decentralized approach to data sharing which does not require centralized administration. Users may be in high numbers and interested in different kinds of collaboration and sharing their knowledge, ideas, experiences, etc. Data sources can be in high numbers, fairly autonomous, i.e. locally owned and controlled, and highly heterogeneous with different semantics and structures. What we need then is new, decentralized data management techniques that scale up while addressing the autonomy, dynamic behavior and heterogeneity of both users and data sources. In this context, we focus on two major problems: query processing with uncertain data and management of scientific workflows.

**8.3.2. INRIA International Partners**

We have regular scientific relationships with research laboratories in  
- North America: Univ. of Waterloo (Tamer Özsu), McGill University (Bettina Kemme), Univ. of California, Santa Barbara (Divy Agrawal, Amr El Abbadi).  
- Europe: Univ. of Madrid (Ricardo Jimenez-Periz).

**8.3.3. Visits of International Scientists**

Prof. Amr El Abbadi (UCSB) gave a seminar at LIRMM on cloud data management.

**8.3.4. Participation In International Programs**

We are involved in the following international actions:  
- the CNPq-INRIA project DatLuge (Data & Task Management in Large Scale) with UFRJ (Marta Mattoso, Vanessa Braganholo, Alexandre Lima), LNCC, Rio de Janeiro (Fabio Porto), and UFPR, Curitiba (Eduardo Almeida) to work on large scale scientific workflows;  
- the PICASSO project Scaling GraphDB, with UPC, Barcelona (Josep Lluis Larriba Pey and Victor Muntes Mulero) to work on very large graph database support.  
- FAPERJ-INRIA project Sw/P2Pcloud (Data-centric workflow management in hybrid P2P clouds, 2011-2013) with UFRJ (Marta Mattoso, Vanessa Braganholo, Alexandre Lima) and LNCC, Rio de Janeiro (Fabio Porto) to work on large scale scientific workflows in hybrid P2P clouds.  
- EGI DE Osmoze project SECC (SErVICES for Curricula Comparison, 2011-2012), with Riga Technical University (Janis Grundspenksis, Marité Kirikova) to work on automatic analysis and mapping of conceptual trees and maps acquired from digital documents.