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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.
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/.

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 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

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.

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).
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 $\mathbb{R}^d$ (“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.
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 Tekniillinen Tutkimuskeskus (Finland),
- University of Piraeus,
- France Telecom,
- Telecom Italia,
- National University of Athens,
- Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung,
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. UniverSelf 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 UniverSelf 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:
• Institut français des sciences et technologies des transports, de l’aménagement et des réseaux (IFSTTAR), France;
• European Embedded Control Institute (EECI), France;
• Eidgenössische Technische Hochschule (ETH) Zürich, Switzerland;
• Technische Universität Dortmund, Germany;
• Technische Universität Berlin, Germany;
• Universität Kassel, Germany;
• Ruhr-Universität Bochum, Germany;
• Universidad de Sevilla, Spain;
• Universidad de Valladolid, Spain;
•Università degli Studi dell’Aquila, Italy;
•Università di Pisa, Italy;
•Università degli Studi di Trento, Italy;
•Consiglio Nazionale delle Ricerche, Italy;
•Università degli Studi di Cagliari, Italy;
•Università degli Studi di Padova, Italy;
•Università degli Studi di Pavia, Italy;
•Technische Universität Eindhoven, Netherlands;
•Technische Universiteit Delft, Netherlands;
•Rijksuniversiteit Groningen, Netherlands;
•Kungliga Tekniska Högskolan, Sweden;
•Lunds Universitet, Sweden;
•Laboratoire de Recherche en Informatique LRI - Univ. Paris-Sud
•IMT - Lucca Institute for Advanced Studies IMT Italy.

See also: http://www.hycon2.eu/

Abstract: The FP7 NoE HYCON2, started in September 2010, is a four-year project coordinated by Françoise Lamnabhi-Lagarrigue. It 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.

8.3.3. Major European Organizations with which we cooperate

TU München, Lehrstuhl Esparza (Germany) organisme 1, labo 1 (pays 1)
Unfoldings of Petri nets (reveals relation)

University of Padova, Department of Pure and Applied mathematics (Italy)
Analysis of Contextual nets and their unfoldings

DISCO team, Università degli Studi di Milano (Italy)
Structural analysis of partially ordered structures, in particular orthomodularity.

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 July 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 November 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.
PARSIFAL Project-Team

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 compétivité: SYSTEMTIC 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)
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.
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 Herms.

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)).
- 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. 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);
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.
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 Project

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. 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 Projekt

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, Lusiana 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. National Actions

- The DeFI group participates in 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 in 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: organismes, 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

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/
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 Lareeq. 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

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

- **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

  Participants: Philippe Caillou, Samuel Thiriot.

- **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.

  Participants: Anne Auger, Cyril Furtlehner, Victorin Martin, Maxim Samsonov.

- **ASAP** – 2009-2012 (178 kEur). Apprentissage Statistique par une Architecture Profonde, ANR programme DEFI 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.

- **DESCARWIN** 2010-2013 (201 kEur). Coordonné P. Savéant, Thalès.
  Participants: Matthias Brendel, Mostepha-Redouane Khouadjia, Marc Schoenauer.

- **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, Belgium; 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 Furschungsverbund 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.
6. Partnerships and Cooperations

6.1. Regional Initiatives

6.1.1. Digiteo

Participants: Alain Denise, Duria 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.
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 Delamonica (Smith College, USA) (March - July 2011)
- Octave Etard (Centrale Paris, Imperial College London) (March - July 2011)
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 provider/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), computationaly 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, Stony Brook, 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.
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/~allassonnier/ , 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 [Correspondent], 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 [Correspondent], 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 MEG 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, Odyssey) 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 [Correspondent], 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.
• 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://bisic1.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. 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 Fraigneau (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. 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.
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 A VENIR: “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.aeuropea.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)
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.

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.

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

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 July 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.
IN-SITU Project-Team

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 “Investissements 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).
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 Saiïs.

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 Saiïs.

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 .

8.2.6. ANR PIMI
Participants: Rania Khefifi, Fatiha Saiïs.

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 de?ned 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 uncompleteness. 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)