Activity Report 2011

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7. Contracts and Grants with Industry

7.1. Contracts with Industry

In 2011 we worked again with Quartet FS company, to design a parallel processing of continuous queries in a financial computing software suite. This applied research was a contract between SUPÉLEC and Quartet FS company, has been achieved with the help of two SUPÉLEC students, and is now included in the software products of Quartet FS.

At the end of 2011, we have established three agreements between SUPÉLEC and three different companies to make applied parallel computing research in the areas of finance (Quartet FS), energy (CGGVeritas) and defense (THALES). These contracts will start at the end of 2011 up to April 2012.

7.2. Grants with Industry

At the end of 2011, SUPÉLEC and Thales company planned to start a new PhD in 2012 about parallel computing on new hybrid architectures, and based on a Thales Grant.
7. Contracts and Grants with Industry

7.1. Contracts with Industry

Participants: Nicolas Cherpeau, Romain Merland, Jeanne Pellerin.

The Ph.D. theses of Romain Merland, Nicolas Cherpeau and Jeanne Pellerin are funded by the Gocad consortium.
7. Contracts and Grants with Industry

7.1. Contracts with Industry

Start-up project by T. Bastogne:

Industrial partner: CyberBio (Biocybernetics for Cancerology & Nanomedicine).
Status: in incubation.

7.2. Grants with Industry

CIFRE PhD grant supervised by P. Vallois:

Industrial partner: Caisse Mutuelle du Crédit Agricole.
Title: Claim reserving for insurance.
PhD thesis of M. Geoffray Nichil.

PEPS project (Mathematics-Industry Interactions) led by A. Muller:

Industrial partner: Sport4Spirit (start-up).
Title: Computation of profit probabilities in sports gambling.
Two Internships involved.
CALVI Project-Team (section vide)
CAMUS Team (section vide)
CARAMEL Project-Team (section vide)
7. Contracts and Grants with Industry

7.1. Contracts with Industry

We have no contract with industry. However, we have several relationships with industrial partners like Thales and Netasq and established a lot of others contacts. See the Fi-Ware project.
CASSIS Project-Team

7. Contracts and Grants with Industry

7.1. Research Result Transfer

The BZ-Testing-Tools technology has been transferred to LEIRIOS Technologies, at the end of 2004. LEIRIOS changed its name into 2007 and is now called Smartesting. The partnership between the Cassis project and the R&D department of Smartesting, located at the TEMIS Scientific and Industrial area at Besançon, will be continued through (national and international) projects or with a new transfer protocol. F. Bouquet is scientific consultant of Smartesting.

7.2. European Projects

- **AVANTSSAR** — Automated validation of trust and security of service-oriented architectures. STREP Project funded under 7th FP (Seventh Framework Program) Research area: ICT-2007.1.4 Secure, dependable and trusted infrastructures. The coordinator is the University of Verona (Italy) and Cassis is one of the 10 partners. AVANTSSAR aims to propose a rigorous technology for the formal specification and “Automated VAlidation of Trust and Security of Service-oriented ARChitectures”. This technology will be automated into an integrated toolset, the AVANTSSAR Validation Platform, tuned on relevant industrial case studies.

- **Nessos** is a Network of Excellence on Engineering Secure Future Internet Software Services and Systems in FP7-ICT (starting in October 2010 for a period of 42 months). Nessos has 12 partners and aims at constituting and integrating a long lasting research community on engineering secure software-based services and systems. Partner INRIA is involved through project-teams Arles, Triskell and Cassis. Cassis will focus on developing tools for service security verification and testing tasks.

- **ProSecure (2011-2016)**[^ProSecure]— ERC Starting Grant Project on Provably secure systems: foundations, design, and modularity. This long-term project aims at developing provably secure systems such as security protocols. The goal is to propose foundations for a careful analysis and design of large classes of up-to-date protocols. To achieve this goal, we foresee three main tasks. First, we plan to develop general verification techniques for new classes of protocols that are of primary interest in nowadays life like e-voting protocols, routing protocols or security APIs. Second, we will consider the cryptographic part of the primitives that are used in such protocols (encryption, signatures, ...), obtaining higher security guarantees. Third, we aim at proposing modular results both for the analysis and design of protocols. Véronique Cortier is the leader of the project.

- **SecureChange**[^SecureChange] is funded under the 7th FP (Seventh Framework Program) Research area: ICT-2007.8.6: ICT forever yours. The project will develop processes and tools that support design techniques for evolution, testing, verification, re-configuration and local analysis of evolving software. Our focus is on mobile devices and homes, which offer both great research challenges and long-term business opportunities. The project is lead by Fabio Massacci (University of Trento, Italy) and it has started in February 2009 for a period of 36 months. Cassis is leader of the 7th workpackage (Testing). The local coordinator is Fabrice Bouquet.

[^ProSecure]: http://www.loria.fr/~cortier/ProSecure.html
[^SecureChange]: http://www.securechange.eu
7. Contracts and Grants with Industry

7.1. ANR

We continued in 2011 our activities connected to the existing ANR grants:

- CISIFS (Control of Fluid-structure Interactions), coordinated by Lionel Rosier and Takéo Takahashi: 90500 euros for 4 years (2009-2013);
- MICROWAVES (Microlocal Analysis and Numerical Methods for Wave Propagation), coordinated by Xavier Antoine: 103000 euros for 4 years (2009-2013);
- GAOS (Geometric Analysis of Optimal Shapes), with Antoine Henrot local coordinator: 83130 euros for 3 years (2009-2012);
- GCM (Geometric Control Methods), with Mario Sigalotti local coordinator: 129266 euros for 4 years (2009-2013).
- MOSICOB: this ANR project (2008-2011) is devoted to complex fluids and to fluid-structure interactions. Our work concerns mainly the analysis and simulation of vesicles in a fluid flow.
- ANR ARPEGE program ArHyCo (Since January 2009) is devoted to the stability analysis of hybrid systems with special attention to the observer-based control of multicell power converters;

7.2. FRAE (Fondation de Recherche pour l’Aéronautique et l’Espace)

In March 2010, Karim Ramdani obtained a 2 years funding from FRAE\(^3\) to work on inverse problems in Aeronautics. The project involves two partners: INRIA Nancy Grand-Est (7 participants, from which 5 members of CORIDA) and ONERA Toulouse (4 participants).

7.3. EADS Foundation

We obtained a four years grant (2010-2014) of 147000 euros from EADS foundation. This project aims to develop new efficient numerical methods to solve electromagnetic scattering problems. Part of this grant is used to support the PhD of I. Zangré supervised by X. Antoine and C. Geuzaine (University of Liège). Y. Saad (University of Minneapolis) is also involved in this project.

CORTEX Project-Team (section vide)
MADYNES Project-Team

7. Contracts and Grants with Industry

7.1. INRIA-ALBLF HIMA

Participants: Rémi Badonnel, Oussema Dabbebi, Olivier Festor [Contact].

Dates: July 2008 - December 2011

Partners: Alcatel Lucent, INRIA.

This joint lab brings together research teams from INRIA and Alcatel Lucent Bell Labs for addressing the key challenges of autonomous networking in three critical areas: semantic networking, high manageability, and self-organized networks. Our activity is part of the joint initiative dedicated to high manageability, and focuses on security management aspects with the Alcatel-Lucent Bell Labs teams on network security. Our work in this joint lab concerns the automation of security management. It includes a first activity related to fuzzing, which includes the improvement of the KiF framework as well as the design of novel fuzzing models for Alcatel-Lucent specific protocols. A second activity of the joint lab aims at investigating to what extent risk management strategies can be applied to VoIP infrastructures. The objective is to design and experiment dynamic risk management methods and techniques for voice oriented critical services.

7.2. VAMPIRE

Participants: Olivier Festor [contact], Laurent Andrey.

Dates: March 2000 - February 2012

Partners: EURECOM, INRIA Nancy Grand-Est (MADYNES), Orange Labs, Symantec

VAMPIRE is a research project funded by the French Research Agency (ANR, VERSO ANR-08-VERS-017) coordinated by the team. The goal of the project to investigate new thread security issues induced by Voice Over IP (VoIP) protocols and web2.0. Madynes has the lead on this project.

In this project, we do work on VoIP fuzzing methods, fingerprinting algorithms and Programmable honeypots.

7.3. MAPE

Participants: Isabelle Chrisment [contact], Andrea Oroseanu.

Dates: January 2008 - July 2011

Partners: LIP6-CNRS UPMC Paris 6, INRIA Nancy Grand-Est (MADYNES)

MAPE (Measurement and Analysis of Peer-to-peer Exchanges for pedocriminality fighting and traffic profiling) is a research project funded by the French Research Agency (ANR). The goal of the project is to measure and analyze peer-to-peer exchanges for paedocriminality fighting and traffic profiling.

The main MADYNES contributions to this project are related to the active measurements and the analysis at the application level. The active measurement requires the design of a distributed measurement infrastructure, in order to achieve the best complementarity among the different measurement clients. The issues in the analysis at the application level raises some research questions about how communities are structured and how this can be observed both active and passive measurements.

7.4. ACDA-P2P

Participants: Isabelle Chrisment [contact], Andrea Oroseanu.

Dates: April 2010 - December 2011

Partners: UTT, LORIA (MADYNES)
ACDA P2P (Approche collaborative pour la detection d’attaques dans les reseaux pair a pair) is a research project funded by the GIS 3SGS which aims at strengthening and developing a multidisciplinary community in the field of the surveillance, of the safety and of the safety(security) of the big systems.

The goal of this project is to propose a new monitoring architecture, which is able to observe the peers behavior and to collect measurements relevant to detect attacks while not being intrusive and detectable. KAD and BitTorrent will be studied as target P2P networks.

We focus more specifically on collaboration between distributed probes in charge of directly detecting attacks if possible, or collecting data for a further analysis. This collaboration induces new challenges:

- coordination of collected measurements in order to have a global view of the network;
- design of indicators revealing a malicious behavior;
- optimization of data collection through learning methods;
- security issues to avoid vulnerabilities and weaknesses.

### 7.5. SCAMSTOP

**Participants:** Olivier Festor [contact], Mohamed Nassar.

**Dates** April 2010 - December 2011

**Partners** INRIA Nancy Grand Est (MADYNES)

In traditional telecommunication, various experts estimate that fraud accounts for annual losses at an average of 5% of the operators revenue and still increasing at a rate of more than 10% yearly. Hence, with the openness and low cost structure of voice over IP (VoIP) service one can expect an even higher threat of fraud and higher losses of revenue making fraud and misuse of services one of the main challenges to VoIP providers. Fraud detection has been an active research and development area in the world of banking and credit card industry. In the VoIP area, there is still hardly any research or products that can assist providers in detecting anomalous behaviour. To fill in this gap, SCAMSTOP will provide a complete framework/solution for automatic fraud detection that alarms providers when suspicious behaviour is detected. The design of the SCAMSTOP fraud detection tools will be based on two aspects. On the one side, SCAMSTOP will use well known methods for statistical behavioural modelling and anomaly detection that have proven their efficiency in the area of credit card, banking and telecommunication and apply them to Internet telephony services. Of special interest here is characterizing the normal usage behaviour while taking into consideration the offered service plans and service structure. On the other side, innovative approaches based on multi-protocol event correlation that takes into account the specific nature of VoIP protocols and components will be developed. This solution will not only be designed to achieve a high detection rate but it will also be optimized to be resource efficient as well. To assess the efficiency and usability of the developed tools and mechanisms, the SCAMSTOP fraud detection system will be intensively tested and probed throughout the project. The consortium is a healthy mixture of SMEs including VoIP service provider, VoIP security and signalling products manufacturers as well as reputed research organizations.

We have developed an integrated environment that allows an operator to perform various clustering activities on call detail records and use profiles. In a cooperation with the University of Liege, we have also investigated alternative methods to detect fraud in Voice over IP systems. A decision tree approach was designed to automatically classify INVITE messages as SPIT or normal based only on the content and order of their fields. A supporting architecture enabling user reporting of SPIT was also designed in this work.

### 7.6. FIREFLIES RTLS

**Participants:** Laurent Ciarletta [contact], Olivier Festor.
Priyadarsi Nanda (University of Technology of Sydney), Ye-Qiong Song, Bilel Nefzi and Hugo Cruz Sanchez (TRIO research team, INRIA Nancy-Grand-Est) are contributing to this activity. Tom Leclerc and Alexandre Boeglin have been punctually participating.

Dates March 2009 - December 2012

Partners  FIREFLIES RTLS

As part of our effort in Pervasive Computing research, we’ve started to work with Fireflies RTLS, a French startup specialized in advanced geolocation services. They aim at providing long-term and resilient location service for high value assets using active RFID tags.

In 2011, the project has been refocused towards energy-constraints addressing, routing and management. This explains the joint-work with the TRIO team, and the arrival and Pr. Nanda from the University of Sydney. We are in the process of conducting a thorough evaluation of the Fireflies framework against standards and state of the art solutions in those areas. We are both building a local testbed and an extended simulation environment with a set of usage scenarii that are to be fed by real experiments. We are also working in improving the depth (number of hops) and the overall life-span of the sensor network in line with their application needs.
MAGRIT Project-Team (section vide)
6. Contracts and Grants with Industry

6.1. Contracts with Industry

6.1.1. Consulting for Core Security Technologies

Participant: Jörg Hoffmann.

Core Security Technologies is an U.S.-American/Argentinian company providing, amongst other things, tools for (semi-)automated security checking of computer networks against outside hacking attacks. For automation of such checks, a module is needed that automatically generates potential attack paths. Since the application domain is highly dynamic, a module allowing to declaratively specify the environment (the network and its configuration) is highly advantageous. For that reason, Core Security Technologies have been looking into using AI Planning techniques for this purpose. After consulting by Jörg Hoffmann (see also below), they are now using a variant of Jörg Hoffmann’s FF planner – developed during his PhD work at the University of Freiburg, Germany (cf. Section 4.1) – in their product. Core Security Technologies payed Jörg Hoffmann for the consulting as an Auto-Entrepreneur.
6. Contracts and Grants with Industry

6.1. Contract with IAEA

Anopheles arabiensis is the target of a sterile insect technique (SIT) program in Sudan. Success will depend in part upon reasonable estimates of the adult population in order to plan the sizes of releases. It is difficult to obtain good estimates of adult population sizes for this mosquito because of the low density of the populations and also because the temporal and spatial distribution of Anopheles arabiensis is very dynamic. We have developed a compartmental model capable of predicting the range of adult populations of Anopheles arabiensis in two study sites in the North of Sudan. We have provided a software that is “user friendly” and that is able to give an estimate of the whole male and female population for the two geographical areas. A screenshot of the soft user interface is presented in Figure 5.

![Figure 5. Anopheles estimator: screenshot of the soft user interface](image-url)
7. Contracts and Grants with Industry

7.1. The BioIntelligence Project

Participants: Mehwish Alam, Isiru Bayissa, Aleksey Buzmakov, Adrien Coulet, Marie-Dominique Devignes, Mehdi Kaytoue, Luis Felipe Melo, Amedeo Napoli [contact person], Chedy Raïssi, Malika Smaïl-Tabbone.

The objective of the “BioIntelligence” project is to design an integrated framework for the discovery and the development of new biological products. This framework takes into account all phases of the development of a product, from molecular to industrial aspects, and is intended to be used in life science industry (pharmacy, medicine, cosmetics, etc.). The framework has to propose various tools and activities such as: (1) a platform for searching and analyzing biological information (heterogeneous data, documents, knowledge sources, etc.), (2) knowledge-based models and process for simulation and biology in silico, (3) the management of all activities related to the discovery of new products in collaboration with the industrial laboratories (collaborative work, industrial process management, quality, certification). The “BioIntelligence” project is led by “Dassault Systèmes” and involves industrial partners such as Sanofi Aventis, Laboratoires Pierre Fabre, Ipsen, Servier, Bayer Crops, and two academics, Inserm and Inria. An annual meeting of the project usually takes place in Sophia-Antipolis at the beginning of July.

Three thesis related to “BioIntelligence” are beginning in the Orpailleur team. A first one is in concern with ontology re-engineering in the domain of biology. The objective is consider the content of the BioPortal ontologies and to design formal contexts with which we will be able to build a concept lattice, to be used as a support for an ontology schema. The formal concept is built according to external resources such as Wikipedia and domain knowledge as well.

A second thesis is related to the study of possible combination of mining methods on biological data. The mining methods which are considered here are based on FCA and RCA, itemset and association rule extraction, and inductive logic programming. These methods have their own strengths and provide different special capabilities for extending domain ontologies. A particular attention will be paid to the integration of heterogeneous biological data and the management of a large volume of biological data while being guided by domain knowledge lying in ontologies (linking data and knowledge units). Practical experiments will be led on biological data (clinical trials data and cohort data) also in accordance with ontologies lying at the NCBO BioPortal.

A third thesis is based on an extension of FCA involving Pattern Structures on Graphs. The idea is to be able to extend the formalism of pattern structures to graphs and to apply the resulting framework on molecular structures. In this way, it will be possible to classify molecular structures and reactions by their content. This will help practitioners in information retrieval tasks involving molecular structures or the search for particular reactions.

7.2. The Quaero Project

Participants: Victor Codocedo [contact person], Amedeo Napoli.

The Quaero project (http://www.quaero.org) is a program aimed at promoting research and industrial innovation on technologies for automatic analysis and classification of multimedia and multilingual documents. The partners collaborate on research and the realization of advanced demonstrators and prototypes of innovating applications and services for access and usage of multimedia information, such as spoken language, images, video and music.
In this framework, the Orpailleur team participates in the task called “Formal Representation of Knowledge for Guiding Recommendation”, whose objectives are to define methods and algorithms for building a “discovery engine” guided by domain knowledge and able to recommend a user some content to visualize. Such a discovery engine has to extend capabilities of usual recommender systems with a number of capabilities, e.g. to select among a huge amount of items (e.g. movie, video, music) those which are of interest for a user according to a given profile. In addition, the discovery engine should take into account contextual information that can be of interest such as news, space location, moment of the day, actual weather and weather forecast, etc. This contextual information changes within time and extracted information has to be continuously updated. Finally, the system has be able to justify or explain the recommendations.

A thesis takes place in the context of the Quaero project. At the moment, document annotation is especially studied for enhancing recommendation but also information retrieval. Information retrieval guided by domain knowledge can be used for selecting resources of interest for these two tasks. Then knowledge discovery based on Formal Concept Analysis can be used for extracting patterns of interest w.r.t. the context and for enriching the domain and contextual knowledge base.

Finally, the discovery process has to be able to act as a classifier and as an inference engine at the same time for reasoning and classifying elements for recommendation and retrieval.
PAREO Project-Team (section vide)
7. Contracts and Grants with Industry

7.1. Introduction

Our policy in terms of technological and industrial partnership consists in favoring contracts that quite precisely fit our scientific objectives. We are involved in an ANR project about audiovisual speech synthesis, another about acoustic-to-articulatory inversion of speech (ARTIS), another about the processing of articulatory data (DOCVACIM) and in a national evaluation campaign of automatic speech recognition systems (ETAPE). We also coordinated until January 2009 the 6th PCRD project ASPI about acoustic-to-articulatory inversion of speech, and the Rapsodis ARC until October 2009.

In addition, we are involved in several regional projects.

7.2. Regional Actions

7.2.1. CPER MISN TALC

The team is involved in the management of the Contrat Plan Etat-Région (CPER) contract. In particular, Christophe Cerisara is co-responsible, with Claire Gardent, of the CPER MISN TALC, which objective is to leverage collaborations between regional academic and private partners in the domain of Natural Language Processing and Knowledge engineering. The TALC action involves about 12 research teams and 40 researchers for a budget of about 240,000 euros per year.

In addition to the co-management of this project, our team is also involved in two scientific collaborative operations:

- An operation about text-to-speech alignment, in collaboration with the TALARIS research team and the ATILF laboratory. This operation aims at proposing semi-supervised solutions to facilitate the transcription and processing of large bimodal text and speech corpora. The main outcomes of this operation are (1) the JTrans software described in section 5.6, and a concordancer that was developed in Java by two BSc students in the framework of their final year project.

- An operation about syntactic analysis of speech transcripts, in collaboration with the TALARIS research team and the ATILF laboratory. This operation aims at adapting state-of-the-art stochastic parsers to the specificities of manual and automatic transcriptions of speech, and at building a French treebank of broadcast news speech transcripts. The main outcome of this operation is the J-Safran software, described in section 5.5.

7.2.2. “Intonale”: Perception and production of prosodic contours in L1 and L2

This action, launched by the CCOSL, aims at developing collaboration between academic partners from Lorraine laboratories and universities. It has started in September 2009 and should last until the end of 2011. The speech team from LORIA is associated with the laboratory ATILF (Mathilde Dargnat). The project deals with the perception and production of prosodic contours in the first language (L1) and in a second language (L2). We have chosen two radically different languages with respect to prosody: French and English. We have collected a corpus recorded by 34 French speakers and made up of sentences with different modalities: assertions, questions, major and minor continuations. French speakers uttered these sentences both in French (their native language) and in English (the “targeted” non-native language). The English part of the corpus is used by the project ALLEGRO, presented hereafter. The French part of the corpus is currently segmented, whilst its English part is segmented under the framework of the INTERREG project ALLEGRO. In order to record corpora in other languages, we improved the Corpus Recorder software (see 5.9). The previous corpus had also been recorded by native English speakers (French and English sentences).
7.3. National Contracts

7.3.1. ADT Handicom

An ADT (Action of Technological Development), was led from 2008 till 2010, managed by Agnès Piquard-Kipffer. The aim of this project is to provide help for improving French Language Acquisition for hard of hearing (HOH) children or for children with language disabilities.

A collection of three digital books has been written by Agnès Piquard-Kipffer and a web interface has been created in order to create others books for language impaired children.

A workflow which transforms a text and an audio source in a video of digital head has been developed. This workflow includes:

- An automatic speech alignment has been integrated. This process can retrieve from an acoustic signal and a text transcription, the length and the position of each phoneme and of each word. This allows a synchronization of the articulation of the head with acoustic signal and text display. This technology is a recognition engine, result of a previous work called ESPERE from EPI PAROLE.
- A Phonetic transcription designed in the EPI Parole has been integrated and adapted.
- A Speech synthetizer has been integrated. This technology can create an artificial voice from a text. It’s a part of tools provided to make a digital book. Several software programs are tested in order to find the best result.
- A French cued speech coding and talking head has been improved in order to generate videos on a server. The animation consists in animating a 3D talking head, in association with a 3D hand which can code cued speech. This technology was created from a previous RIAM project called LABIAO.

A digital book written in FLASH has been developed. It integrates videos of the digital head, which are synchronized with texts displayed for each page. Digital books can be created manually with a text editor (to create XML file) or automatically with software which can be easily used to add all necessary multimedia elements in pages.

Data (audio source and text) are provided from a web interface. This web site allows users to create digital books. Through this interface, the books can be easily modified, shared and read. This website has been developed with Symfony (PHP 5 web framework) and AJAX (Dojo toolkit API) technologies. A linguistical study and a case study analysis of the current version of the talking head and of the digital books were conducted in collaboration (for feasibility studies), both with the Speech Therapy School of Nancy (with 8 students : Floriane Jacques, Amélie Dumont, Sophie Bardin, Elodie Racine, Claire Nostrenoff, Anaïs Laurenceau, Hélène Thiollier and Marie Gabet) and with National Education with two schools and specialized teachers (Hélène Adam-Piquard and Sylvie Nussbaum).

7.3.2. ANR DOCVACIM

This contract, coordinated by Prof. Rudolph Sock from the Phonetic Institute of Strasbourg (IPS), addresses the exploitation of X-ray moving pictures recorded in Strasbourg in the eighties. Our contribution is the development of tools to process X-ray images in order to build articulatory model [35]. This year we incorporated tools to withdraw jumps in X-ray films, which are due to the driving of the film during recording. We also developed an analysis procedure to delineate velum contours and to analyze its deformations.

7.3.3. ANR ARTIS

This contract started in January 2009 in collaboration with LTCI (Paris), Gipsa-Lab (Grenoble) and IRIT (Toulouse). Its main purpose is the acoustic-to-articulatory inversion of speech signals. Unlike the European project ASPI the approach followed in our group will focus on the use of standard spectra input data, i.e. cepstral vectors. The objective of the project is to develop a demonstrator enabling inversion of speech signals in the domain of second language learning.
This year the work has focused on the development of the inversion infrastructure using cepstral data as input. We checked that the codebook represents the articulatory to acoustic mapping correctly and we also developed the optimization of the bilinear transform in order to make the comparison of natural and synthetic spectra possible.

### 7.3.4. ANR ViSAC

This ANR Jeunes Chercheurs started in 2009, in collaboration with Magrit group. The main purpose of ViSAC (Acoustic-Visual Speech Synthesis by Bimodal Unit Concatenation) is to propose a new approach of a text-to-acoustic-visual speech synthesis which is able to animate a 3D talking head and to provide the associated acoustic speech. The major originality of this work is to consider the speech signal as bimodal (composed of two channels acoustic and visual) "viewed" from either facet visual or acoustic. The key advantage is to guarantee that the redundancy of two facets of speech, acknowledged as determining perceptive factor, is preserved.

Currently, we designed a complete system of the text to acoustic-visual speech synthesis based on a relatively small corpus. The system is using bimodal diphones (an acoustic component and a visual one) and it is using unit selection techniques. Although the database for the synthesis is small, however the first results seem to be very promising. The developed system can be used with a larger corpus. We are trying to acquire/analyze an 1-2 hours of audiovisual speech. With a larger corpus, the quality of the synthesis will be obviously much better.

The next year, we will mainly evaluate the system using both subjective and objective perceptual evaluation.

### 7.4. Grants with Industry

#### 7.4.1. Timecode

We begin a collaboration with the Timecode company that works in dubbing (recording and replacing voices on a motion picture or television soundtrack). We want to use tools developed in our team to speed up the process of making a rythmo band (or "lip-sync band"). The band is actually a clear 35 mm film leader on which the dialogue is written, along with numerous additional indications for the actor (laughs, cries, length of syllables, mouth sounds, breaths, mouth openings and closings, etc.). The rythmo band is projected in the studio and scrolls in perfect synchronization with the picture. We have designed a tool for automatic alignment of the rythmo band and the audio file.
SCORE Team

7. Contracts and Grants with Industry

7.1. CIFRE Grant with SAP Research

Participants: François Charoy, Joern Franke.

Since several years, we are strengthening our relationships with SAP Research in the areas of process management and security. This collaboration has been formalized in 2008 by the funding of Joern Franke under a CIFRE contract to work on a PhD thesis on process models for crisis management (or crisis process managements systems). The PhD has been defended in october 2011.
Sémagramme Team (section vide)
TALARIS Project-Team (section vide)
7. Contracts and Grants with Industry

7.1. Contracts with Industry

7.1.1. ANR projects

- N. Champagnat is member of the ANR MANEGE (Modèles Aléatoires eN Écologie, Génétique et Évolution, started in 2009 under the direction of S. Méléard, Ecole Polytechnique) whose aim is to provide methodological and conceptual advances in the study of stochastic processes modeling ecology, population genetics and evolution of life. This work is sustained by regular exchanges with biologists from several teams in France. In addition, the three working groups that operate in each of the three poles of the MANEGE project (Paris, Palaiseau, Marseille) gather all local probabilistic interests in the issues of this project. http://www.cmap.polytechnique.fr/~anr-manege/index_en.html

- N. Champagnat is member of the ANR MODECOL (Using mathematical MODeling to improve ECOLogical services of prairial ecosystems, started in 2009 under the direction of C. Mony, Univ. Rennes 1), whose goal is to develop computational ecological modeling of terrestrial plants communities via the simulation of a prairie in relation with environmental data. This project focuses on developing an original tool-box that takes advantage of complementary mathematical disciplines (partial differential equations, individual-based stochastic modelling...) to assess ecological problems. Simulations will be extensively processed using distributed computing and webcomputing. Our target application concerns the setup of herbal strips around intensive cereal fields for purifying water from extra nitrate and pesticides, imposed by the European Common Agricultural Policy. http://ecobio.univ-rennes1.fr/modecol/gb/description.php

- S. Herrmann, D. Talay and E. Tanré are member of the ANR MANDy (Mathematical Analysis of Neuronal Dynamics, started in 2009 under the direction of M. Thieullen, Univ. Paris 6). This project, which gathers mathematicians and neuroscientists, aims at developing mathematically rigorous approaches to neuroscience considering single neurons as well as interconnected neuronal populations. Our target is to conduct the mathematical analysis of existing models where there is still much work to be done and to enrich the modelling by proposing new models. See http://www.proba.jussieu.fr/pageperso/thieullen/MANDy/accueil.html for a more complete description of this project.

- P.-E. Jabin is member of the ANR MONUMENTALG (MOdélisation mathématique et simulations NUMériques pour la dégradation biologique des MONUMENTs et pour la prolifération des ALGues) on the dispersion of toxic algae, starting in 2010 (dirercted by M. Ribot, Univ. Nice – Sophia Antipolis). http://math.unice.fr/~ribot/anr.html

- A. Lejay is member of the ANR ECRU (Exploration des Chemins RUgueux, 2009–2011), whose aim is to explore new directions in the field of rough paths (directed by M. Gubinelli, Univ. Paris Dauphine). http://www.ceremade.dauphine.fr/~mgubi/ecru/index.html

- A. Lejay is member of the ANR SIMUDMRI (Simulation du signal d’IRM diffusion dans tissus biologiques) which started in November 2010 (directed by Jing-Rebecca Li, INRIA Rocquencourt).

7.1.2. Contracts with ADEME

Participants: Mireille Bossy, El Hadj Aly Dia, Jacques Morice, Laurent Violeau.
Local modeling for the wind velocity Since 2005, M. Bossy was member of a collaboration with the Laboratoire de Météorologie Dynamique (Université Paris 6, École Polytechnique, École Normale Supérieure), funded by the French Environment and Energy Management Agency (ADEME), concerning the modeling and the simulation of local wind energy resources. We collaborate with P. Drobinski. This year was the last year of the second phase of this collaboration started in October 2007, with two other partners: A. Rousseau (MOISE team, INRIA Grenoble – Rhône-Alpes) and F. Bernardin (CETE Clermont-Ferrand).

We investigated a new numerical simulation method for the downscaling in CFD, with a strong orientation in applications to meteorology, particularly for the simulation of wind at small scales. The local model that we propose consists in modeling the fundamental equations of fluid motion by a stochastic Lagrangian model describing the behaviour of a fluid particle.

Because of the both Lagrangian and stochastic nature of our model, it is discretized thanks to an interacting particle system, combining a time Euler scheme for stochastic differential equations and a Monte–Carlo approximation method. This model called SDM (Stochastic Downscaling Method) is adapted from previous works introduced by S.B. Pope [41] (see http://sdm.gforge.inria.fr/Accueil/index.en.php).

This year, we worked on the comparison of the SDM model (endowed with a physical geostrophic forcing and a wall log law) with simulations obtained with a LES method (Méso-NH code) for the atmospheric boundary layer (from 0 to 750 meters in the vertical direction), in the neutral case.

This work allowed to deeply understand the contribution of each elements of the Lagrangian model in terms of the turbulence production and dissipation, we analysed the returns of various closure parametrisation approaches, including viscosity turbulent approach. We also investigated anisotropic effect, with the introduction of a GLM model in SDM (see [41]), in particular the isotropic relaxation case. We gave our conclusions as a part of the final report for ADEME [28], http://hal.inria.fr/hal-00646422/en. A paper is in preparation.

Carbon value and carbon tax in the context of renewable energies deployment Since January 2009, M. Bossy was member of a collaboration funded by the French Environment and Energy Management Agency (ADEME), involving the Center for Applied Mathematics (CMA) at Mines ParisTech, and COPRIN and TOSCA teams at INRIA Sophia Antipolis. It focuses on a short term carbon value derived from the so-called financial carbon market, the European Union Emission Trading Scheme (EU ETS), which is a framework for GHG emissions reduction in European industry.

The objective of this project is to study the compatibility and complementarity of a carbon tax and a target for renewable energy deployment. As a first step, we are developing a method for assessing the EU ETS value. We consider the constraints related to emission allowances distributed through national plans of allocation (NAP) and the mechanisms of taxes that are taking place. The work will focus on electricity producers, key players in the market in its first phase (NAP-I, 2005-2007). The impact of the Renewable Energies park of the electricity producers on their own carbon value will be particularly studied.

We have selected the financial concept of indifference price as a relevant methodology to assess the European Union Emission Trading Scheme (EU ETS) value. In this setting, modelling strategies of production and emission of market quotas rely on stochastic optimal control problems and associated Hamilton-Jacobi-Bellman equations.

This year, we worked on the calibration (with EPEX Spot data) of the selected panel of electricity spot price models, as input of the indifference price solver. We also added the reduction cases (studied in our collaboration with CMA-MinesParisTech mentioned above) into the solver and we started to implement the 3D case solver, required for some electricity spot price models. We used the current version of CarbonQuant to compare a tax situation with the allowances market situation.
We also continued the study of a game theoretic approach based on the Nash equilibrium concept for the coupled electricity and carbon markets (see the 2011 Activity Report of the COPRIN team).

### 7.1.3. Industrial contracts

- **TOSCA Nancy** starts a working group with the SME Alphability on risk measures and rare events in finance.
- The contract between **TOSCA** and GDF-Suez on the hedging of power plants ended in January.
- In collaboration with V. Reutenauer (CA-CIB) D. Talay and E. Tanré worked on the contract with CA-CIB (ex-CALYON), which concerned
  - the study of the liquidity risk in the interest rate options market;
  - the minimization of the hedging error in interest rates Gaussian models by means of strategies designed in an effective way by using stochastic optimization algorithms.

This contract ended this year.
TRIO Project-Team (section vide)
VEGAS Project-Team (section vide)
VERIDIS Team

7. Contracts and Grants with Industry

7.1. ANR project DeCert

Participants: Pascal Fontaine, Stephan Merz, Bruno Woltzenlogel Paleo.

The DeCert (Deduction and Certification) project is being funded by ANR from 2009–2012 within its “Domaines émergents” program. It is coordinated by the Celtique project team of INRIA Rennes, the other partners are academic teams from INRIA Saclay (Proval) and INRIA Sophia Antipolis (Marelle) as well as the CEA and the Systerel company. In Nancy, the project also involves members of the Cassis team, in particular Alain Giorgetti and Christophe Ringeissen.

The objective of the project is to study certified decision procedures, including the design of appropriate certificates, the development of new certifying decision procedures, their combination, their integration with skeptical proof assistants such as Coq or Isabelle, and their use in application domains such as software verification or static analysis. The main lines of research concern questions of expressiveness vs. efficiency, certificates vs. proof objects, and the integration of certificates into verification environments. Our work within the project is related to veriT (see section 5.1), its proof production, and its integration with verification environments such as Isabelle or the TLA+ proof environments (see section 5.2).

7.2. Tools and Methodologies for Formal Specifications and for Proofs

Participants: Stephan Merz, Hernán-Pablo Vanzetto.

We participate in the project on Tools and Methodologies for Formal Specifications and for Proofs at the MSR-INRIA Joint Centre. The objective of the project is to develop a proof environment for verifying distributed algorithms in TLA+ (see also sections 5.2 and 6.4). The project in particular funds the PhD thesis of Hernán Vanzetto.

7.3. Diagnosis of errors in network controlled systems

Participants: Diego Caminha Barbosa de Oliveira, Pascal Fontaine, Stephan Merz.

In an exploratory project with Westinghouse France, we studied the possibility of using formal verification technology (in particular model checking and SAT/SMT solving) for diagnosing possibly transient faults in communication networks. The diagnosis is based on logs that are generated by periodic self tests. In particular, the SAT solver of veriT has been interfaced with Matlab so that it can be used by our industrial partner for determining causes of certain permanent faults. We have also used Uppaal to model a simplified version of a protocol used by our industrial partner in order to determine timing intervals for the occurrence of faults detected in logs.