



RESEARCH CENTER  
Lille - Nord Europe

FIELD

Activity Report 2012

# Section Partnerships and Cooperations

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## ADAM Project-Team

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

**Adapt** is a local ADT (Action de Développement Technologique) of the Inria Lille - Nord Europe Center and aims at building a demonstrator of our ADAM software technologies in the application domain of smart digital homes. Firstly, this demonstrator will show adaptive and reflective capabilities of FraSCAti (see Section 5.5), *i.e.*, supporting various implementation languages (*e.g.*, Java, WS-BPEL, scripting languages, template technologies) to develop business components, supporting various remote communication protocols (*e.g.*, SOAP, REST, JMS, JGroups) to access and expose services, supporting various non functional properties, deploying business components on demand, and reconfiguring business applications/components/services at runtime. Secondly, these capabilities will be illustrated on several ambient intelligence scenarios, *e.g.*, Fire Emergency and Home Automation. Thirdly, this demonstrator will integrate our recent and future scientific results in the domains of dynamic software product lines, autonomic computing, control loops, complex event processing, energy control, etc. Gwenael Cattez (recent graduated engineer) has been recruited in the context of this ADT.

**Participants:** Gwenael Cattez, Philippe Merle.

## 8.2. National Initiatives

### 8.2.1. ANR

**SALTY** is a 36-month ANR ARPEGE project started in November 2009 and involving University of Nice, Deveryware, EBM WebSourcing, Inria ADAM, MAAT-G France, Thales, University Paris 8 and University Paris 6. The main objective of the SALTY project is to provide an autonomic computing framework for large-scale service-oriented architectures and infrastructures. The SALTY project will result in a coherent integration of models, tools and runtime systems to provide a first end-to-end support to the development of autonomic applications in the context of large-scale SOA in a model-driven way, including never-covered aspects such as the monitoring requirements, the analysis (or decision-making) model, and an adaptation model tackling large-scale underlying managed components. The project will be validated by two large use-cases: a neurodegenerative disease study for exploring the capacity of grid infrastructures and a path tracking application for exploiting the different positioning methods and appliances on a fleet of trucks.

**Participants:** Laurence Duchien, Russel Nzekwa, Romain Rouvoy, Lionel Seinturier.

**SocEDA** is a 36-month ANR ARPEGE project started in November 2010 and involving EBM WebSourcing, ActiveEon, EMAC, I3S, LIG, LIRIS, Inria ADAM, France Telecom and Thales Communications. The goal of SocEDA is to develop and validate an elastic and reliable federated SOA architecture for dynamic and complex event-driven interaction in large highly distributed and heterogeneous service systems. Such architecture will enable exchange of contextual information between heterogeneous services, providing the possibilities to optimize/personalize their execution, according to social network information. The main outcome will be a platform for event-driven interaction between services, that scales at the Internet level based on the proposed architecture and that addresses Quality of Service (QoS) requirements.

**Participants:** Nabil Djarallah, Gabriel Hermosillo, Fawaz Paraiso, Romain Rouvoy, Lionel Seinturier.

**MOANO** (Models & Tools for Pervasive Applications focusing on Territory Discovery) is a 36-month project of the ANR CONTINT program which started in January 2011. The partners are LIUPPA/University of Pau and Pays de L'Adour, University of Toulouse/IRIT, University of Grenoble/LIG, University of Lille/LIFL/Inria. While going through a territory, mobile users often encounter problems with their handheld computers/mobiles. Some locally stored data become useless or unnecessary whereas other data is not included in the handheld computer. Some software components, part of the whole applications can become unnecessary to process some information or documents that the user did not plan to manage during his mission. In order to answer such difficulties, our project has three operational studies which are i) to enlarge the communication scale, ii) to provide people without computer-science skills with a toolset that will enable them to produce/configure mapping applications to be hosted on their mobile phone and iii) to process all the documents of interest in order to make their spatial and thematic semantics available to mobile users.

**Participants:** Nabil Djarallah, Laurence Duchien, Nicolas Petitprez.

**YourCast** (Software Product Lines for Broadcasting Systems) is a 18-month ANR Emergence project that started in 2012 and that involves University of Nice Sophia Antipolis, Valorpaca and Inria ADAM. The project aims at defining an information broadcasting system by a dedicated software product line which will be used in schools or events, such as gatherings of scouts.

**Participants:** Laurence Duchien, Daniel Romero.

### 8.2.2. Competitiveness Clusters

**Macchiato** is a 36-month project of the competitiveness cluster PICOM (**Pôle des Industries du Commerce**), which has started in January 2011. The partners of this project are Auchan (leader), University of Bordeaux/LABRI, Inria, and the Web Pulser SME. The Macchiato project aims at rethinking the design of e-commerce sites to better integrate the Internet of Things and facilitate online sales. In addition to setting up an infrastructure and a common application base, this challenge needs to refocus the design of e-commerce sites on the concept of "single electronic cart". We believe that including the next generation of e-commerce sites will enable to offer a personalized offer to consumers by adapting the content and form of the web sites to their preferences and needs and will allow them to manage their purchases uniformly with a single electronic cart [118].

**Participants:** Nabil Djarallah, Laurence Duchien, Nicolas Petitprez, Romain Rouvoy.

**EasySOA** is a 24-month project funded by FUI and labeled by the **Systematic** competitiveness cluster for Open Source Software. The project started in 2011. The partners of this project include Open Wide (leader), Bull, Easyfab, Inria, Nuxeo, Talend. The EasySOA goal is to add an open, light, agile layer on top of "traditional" SOA, thanks to an online, social and collaborative approach, involving all actors of the SOA process. Beyond cartography and documentation, it helps gathering and fast-prototyping the business needs, and eases the transition to final implementations in the existing SOA solution.

**Participants:** Antonio de Almeida Souza Neto, Michel Dirix, Jonathan Labéjof, Philippe Merle, Christophe Munilla.

**EconHome** is a 30-month project funded by FUI and labeled by the Minalogic and Systematic competitiveness clusters. The project started in 2011. The partners of this project include Sagemcom, Orange, STMicroelectronics, ST-Ericsson, SPiDCOM, Utrema, COMSIS, DOCEA, CEA, ETIS. The project aims at reducing the energy consumption of home and middleware networks. The target is to reduce of at least 70% the energy consumption of devices such as residential gateways, set top boxes, CPL plugs. Two axes are investigated: the optimization of the energy consumption of individual devices with innovative low power and sleep modes, and the optimization of the overall network with innovative techniques, such as service migration and energy aware service feedbacks to the user.

**Participants:** Aurélien Bourdon, Rémi Druilhe, Laurence Duchien, Adel Nouredine, Romain Rouvoy, Lionel Seinturier.

**Hermes** is a 36-month project funded by FUI and labeled by the PICOM (**Pôle des Industries du COMmerce**) competitiveness cluster which has started in November 2012. The goal of the project is to define a modular and context-aware marketing platform for the retail industry. The focus is put on the interactions with customers in order to extract and mine relevant informations related to shopping habits, and on a multi-device, cross-canal, approach to better match customer usages.

**Participants:** Laurence Duchien, Romain Rouvoy, Lionel Seinturier.

### 8.2.3. Inria

**ARC SERUS** (Software Engineering for Resilient Ubiquitous Systems) is founded by the Inria collaboration program. The partners are Inria ADAM, Inria PHOENIX and TSF-LAAS (CNRS). Resilience is defined as the ability of a system to stay dependable when facing changes. For example, a building management system (*e.g.*, anti-intrusion, fire detection) needs to evolve at runtime (*e.g.*, deployment of new functions) because its critical nature excludes interrupting its operation. Resilience concerns occur in various application domains such as civil systems (civil protection, control of water or energy, etc.) or private systems (home automation, digital assistance, etc.). The objectives of this project is to propose a design-driven development methodology for resilient systems that takes into account dependability concerns in the early stages and ensures the traceability of these requirements throughout the system life-cycle, even during runtime evolution. To provide a high level of support, this methodology will rely on a design paradigm dedicated to sense/compute/control applications. This design will be enriched with dependability requirements and used to provide support throughout the system life-cycle.

**Participants:** Laurence Duchien, Alexandre Feugas, Lionel Seinturier.

**ADT AntDroid** (2012–2014) is a technology development initiative supported by Inria that aims at pushing the results of Nicolas Haderer's PhD thesis into production. AntDroid therefore focuses on deploying and disseminating the *Bee.sense* software platform to the public and to support the users of the platform. *Bee.sense* is a distributed platform dedicated to crowd-sensing activities. *Bee.sense* exploits the sensors of mobile devices that are shared by participants to observe physical or behavioral phenomenons. The challenges related to the development of such a platform encompasses user privacy and security, battery preservation, and user accessibility.

**Participants:** Romain Rouvoy, Nicolas Haderer.

## 8.3. European Initiatives

### 8.3.1. FP7 Projects

Program: FP7 ICT

Project acronym: **PaaSage**

Project title: Model Based Cloud Platform Upperware

Duration: October 2012–September 2016

Coordinator: ERCIM

Other partners: ERCIM (Fr), SINTEF (No), STFC (UK), U. of Stuttgart (De), Inria (Fr), CETIC (Be), FORTH (El), Be.Wan (Be), EVRY Solutions (No), SysFera (Fr), Flexiant (UK), Lufthansa Systems AG (De), Gesellschaft für wissenschaftliche Datenverarbeitung mbH Göttingen (De), Automotive Simulation Center Stuttgart (De).

Abstract: Cloud computing is a popular and over-hyped concept in ICT. The concept of infinitely scalable elastic resources changing without complex systems administration and paying only for resources used is attractive. These benefits are not immediately realizable. Within organisation benefits are realizable at considerable cost. IaaS (Infrastructure as a Service) public CLOUDs have different interfaces and conditions of use thus for an organisation to 'scale out' requires considerable investment using skilled technical staff. The business need is to allow organisations to "scale out" from their private CLOUD to public CLOUDs without a technical chasm between. This cannot

easily be achieved. Aligned with the EU strategic direction of an open market for services, SOA (service-oriented architecture) offers a way to virtualize across heterogeneous public CLOUDs and organizational private CLOUDs. It opens a market for European SMEs to provide services to be utilized (and paid for) by business applications and for all organisations to benefit from a catalogue of services that can be used across the environment. PaaSage will deliver an open and integrated platform, to support both deployment and design of Cloud applications, together with an accompanying methodology that allows model-based development, configuration, optimisation, and deployment of existing and new applications independently of the existing underlying Cloud infrastructures. Specifically it will deliver an IDE (Integrated Development Environment) incorporating modules for design time and execution time optimisation of applications specified in the CLOUD Modeling Language (CLOUD ML), execution-level mappers and interfaces and a metadata database.

Participants: Laurence Duchien, Romain Rouvoy, Lionel Seinturier.

Program: FP7 FET

Project acronym: **DIVERSIFY**

Project title: More software diversity. More adaptivity in CAS.

Duration: 36 months

Coordinator: Inria

Other partners: SINTEF (Norway), Trinity College Dublin (Ireland), University of Rennes 1 (France)

Abstract: DIVERSIFY explores diversity as the foundation for a novel software design principle and increased adaptive capacities in CASs. Higher levels of diversity in the system provide a pool of software solutions that can eventually be used to adapt to unforeseen situations at design time. The scientific development of DIVERSIFY is based on a strong analogy with ecological systems, biodiversity, and evolutionary ecology. DIVERSIFY brings together researchers from the domains of software-intensive distributed systems and ecology in order to translate ecological concepts and processes into software design principles.

Participant: Martin Monperrus.

## 8.4. International Initiatives

### 8.4.1. Inria Associate Teams

#### 8.4.1.1. SEAS

Title: Middleware for Sensor as a Service

Inria principal investigator: Romain Rouvoy

International Partner (Institution - Laboratory - Researcher):

University of Oslo (Norway) - Department of informatics

Duration: 2010–2012

See also: <http://seas.ifi.uio.no>

Middleware for Sensor as a Service (SeaS) is a collaboration initiative that intends to contribute to the vision of the Future Internet as an open-source middleware platform, based on robust Web standards, breaking existing IT silos and leveraging the development of innovative hybrid service-oriented architectures spanning from Wireless Sensor Networks to Ubiquitous and Cloud Computing. Given that one of the objectives of Europe is to develop the convergence of IT networks (being it mobile or fixed) and the fact that many of the upcoming mobile devices are integrating services (from phones down to sensors and radio frequency identification), we believe that one of the challenges for the next generation society will consist in enabling a distributed middleware platform for the dynamic

provision of hybrid services and the scalable dissemination of data. In particular, we believe that the sensor capabilities can be reflected as a service accessible from the Internet or any IT system using standard Web protocols. The resulting services will be hybrid in the sense that they will reflect the wide diversity of sensor devices available nowadays, but we aim at providing a uniform solution to leverage the development of applications on top of physical or virtual sensors. This platform includes not only the sensor level (description, discovery, communication, reconfiguration...), but also the platform level services (dissemination, storage, query, adaptation...) that are required for enabling such a vision. The resulting platform will bring additional opportunities for the development of innovative service-based systems by exploiting the emergence of Wireless Sensor Networks (WSN), Ubiquitous Computing, and Cloud Computing environments.

## 8.4.2. Inria International Partners

### 8.4.2.1. OW2

**OW2**, previously ObjectWeb, is an international consortium to promote high quality open source middleware. The vision of OW2 is that of a set of components which can be assembled to offer high-quality middleware systems. We are members of this consortium since 2002. Philippe Merle is the leader of both FRACTAL and FRASCATI projects, which are hosted by this consortium. Philippe Merle and Lionel Seinturier are members of the Technology Council of OW2.

**Participants:** Philippe Merle, Romain Rouvoy, Lionel Seinturier.

### 8.4.2.2. ERCIM Working Group on Software Evolution

The **Working Group (WG) on Software Evolution** is one of the working groups supported by ERCIM. The main goal of the WG is to identify a set of formally-founded techniques and associated tools to support software developers with the common problems they encounter when evolving large and complex software systems. With this initiative, the WG plans to become a Virtual European Research and Training Centre on Software Evolution.

**Participant:** Laurence Duchien.

### 8.4.2.3. University of Los Andes, Bogota, Colombia

The ADAM project-team has a long term collaboration since 2005 with this university. Over the years, four PhD thesis (Carlos Noguera, Carlos Parra, Daniel Romero, Gabriel Tamura) have been defended in our team with students who obtained their MSc in this university. The first three were full French PhD, whereas the last one was a co-tutelle with this university. Professor Rubby Casallas from University of Los Andes is frequently visiting our team. The most recently defended PhD thesis, that of Gabriel Tamura, deals with QoS (quality-of-service) contract preservation in distributed service-oriented architectures. A formal theory to perform, in a safe way, the process of self-adaptation in response to quality-of-service (QoS) contracts violation has been proposed. The results have been published in [67], [66] and in the PhD thesis document itself [12].

**Participant:** Laurence Duchien.

## 8.5. International Research Visitors

### 8.5.1. Visits of International Scientists

Patrick Heymans (1 January 2012 to 30 April 2012).

Subject: Software and Information Systems Engineering, Requirements Engineering, Software Product Lines, Software Evolution.

Institution: University of Namur (Belgium).

Gabriel Tamura (October 2012).

Subject: Software architecture, dynamic software adaptation, and engineering of self-adaptive software systems.

Institution: University ICESI (Cali, Colombia).



Norha Villegas (October 2012).

Subject: Application of software engineering models, techniques and architectures to the development of self-adaptive and self-managing systems.

Institution: University of Victoria, Canada.

#### *8.5.1.1. Internships*

Diego Mendez (from June 2012 until November 2012).

Subject: Characterization of API Usage Diversity for Driving API-based Software Repair.

Institution: National University of the Center of the Buenos Aires Province (Argentina).

Daniel René Fouomene Pewo (from May 2012 until October 2012).

Subject: Elastic solution to tolerate peak load of users and queries generated by the so-called Slashdot effect.

Institution: University of Youndé (Cameroun).

Maxence G. de Montauzan (from March 2012 until July 2012).

Subject: An Empirical Study of Exception-Handling Design Strategies In Open-Source Applications.

Institution: University Lille 1 (France).

Anthony Da Costa Maia (from March 2012 until July 2012).

Subject: Extracting Knowledge from the Q&A Website StackOverflow at Debug Time.

Institution: University Lille 1 (France).

Sébastien Poulmane (from June 2012 until August 2012).

Subject: Integrating third-party sensors in the Bee.sense platform.

Institution: University Lille 1 (France).

## **ATEAMS Project-Team**

# **6. Partnerships and Cooperations**

## **6.1. National Initiatives**

### ***6.1.1. Master Software Engineering***

ATEAMS is the core partner in the Master Software Engineering at Universiteit van Amsterdam. This master is a collaboration between SWAT/ATEAMS, Universiteit van Amsterdam, Vrije Universiteit and Hogeschool van Amsterdam.

### ***6.1.2. Early Quality Assurance in Software Production***

The EQUA project is a collaboration among Hogeschool van Amsterdam (main partner) Centrum Wiskunde & Informatica (CWI), Technisch Universiteit Delft, Laboratory for Quality of Software (LaQuSo), Info Support, Software Improvement Group (SIG), and Fontys Hogeschool Eindhoven.

### ***6.1.3. Model-Driven Engineering in Digital Forensics***

In this project ATEAMS works with the Dutch National Forensics Institute on next generation carving software for recovering evidence from damaged or erased data storage media.

### ***6.1.4. Next Generation Auditing: Data-assurance as a service***

This collaboration between Centrum Wiskunde & Informatic (CWI) PriceWaterhouseCoopers (PWC), Belastingdienst (National Tax Office), and Computational Auditing, is to enable research in the field of computational auditing.

## **6.2. European Initiatives**

### ***6.2.1. FP7 Projects***

OSSMETER aims to extend the state-of-the-art in the field of automated analysis and measurement of open-source software (OSS), and develop a platform that will support decision makers in the process of discovering, comparing, assessing and monitoring the health, quality, impact and activity of open-source software. The project started in October 2012. ATEAMS contributes to this project by focusing on software analysis and related areas.

## **6.3. International Research Visitors**

### ***6.3.1. Visits of International Scientists***

- Michael W. Godfrey, PhD, Associate professor - David R. Cheriton School of Computer Science, University of Waterloo, Waterloo, Canada. (full year visit)
- Alex Loh - University of Texas, Austin, U.S.A. (three month internship for excellent PhD students)
- William Cook - University of Texas, Austin, U.S.A.
- Erik Meijer - Microsoft Research, Seattle, U.S.A.
- Oege de Moor - Semmler & Oxford University
- Krzysztof Czarnecki - University of Waterloo, Canada
- Stéphane Ducasse - Inria Lille, France
- Ralf Lämmel - University of Koblenz-Landau, Germany
- Magne Haveraaen - University of Bergen, Norway

- Anya Helene Bagge, PhD - University of Bergen, Norway
- Vlad Rusu - Inria Lille, France
- Ted Kaminsky - University of Minnesota, U.S.A.
- Anthony Cleve - FUNDP, Namur, Belgium
- Anthony Sloane - Macquarie University, Australia
- Elizabeth Scott - RHUL, London, England
- Peter Mosses - University of Swansea, Wales
- Adrian Johnstone - RHUL, London, England

#### *6.3.1.1. Internships*

- Douwe Kasemier
- Arnoud Roo
- Jasper Timmer
- Wietse Venema
- Ashim Shahi
- Jouke Stoel
- Dennis van Leeuwen
- Jeroen Lappenschaar
- Luuk Stevens
- Floris Looijesteijn
- Pieter Brantwijk

#### *6.3.2. Visits to International Teams*

- Tijs van der Storm visited University of Texas Austin for two weeks in November.
- Paul Klint visited University of London and University of Swansea
- Paul Klint visited University of Swansea
- Paul Klint visited FUNDP in Namur
- Jurgen Vinju and Tijs van der Storm visited RMOD at Inria Lille
- Jurgen Vinju visited VUB, Brussels, Belgium
- Vadim Zaytsev visited Universität Koblenz-Landau, Germany

## BONSAI Project-Team

# 7. Partnerships and Cooperations

## 7.1. Regional Initiatives

- At the end of 2010, we started a collaboration with the sequencing platform of Université Lille 2 and IRCL (M. Figeac) and the hematology lab of Lille hospital (N. Gardel, C. Roumier, C. Preudhomme), on the diagnosis of leukemia residual disease. This project has been awarded by a “Projet émergent region” grant for 2012 – 2013.
- Our research on *nonribosomal peptide synthesis* is based on a collaboration with the ProBioGEM laboratory (*Laboratoire des Procédés Biologiques Génie Enzymatique et Microbien*, Université Lille 1). This laboratory develops methods to produce and extract active peptides in agriculture or food. Two PhD thesis has been co-supervised by the two labs.
- We have a long term collaboration with GEPV Lab (Genetics and Evolution in Plants, UMR CNRS 8198, Université Lille 1). Topics includes rearrangements in mitochondrial genomes and evolution of plant miRNAs. One supervised PhD thesis has been defended in 2010, and a new thesis just started in October 2012.
- The team is in charge of the PPF *Bioinformatique*. This is an initiative of Université Lille 1 that coordinates public bioinformatics activities at the local level. It gathers seven labs coming from biology, biochemistry and computer science. Main topics are proteomics, microbiology, population genetics, etc.

## 7.2. National Initiatives

### 7.2.1. ANR

- ANR Mappi (2010-2013, call *Conception and Simulation*). This project involves four partners: LIAFA (Université Paris 7), Genscale (Inria Rennes), Genoscope (French National Center for Sequencing) and BONSAI. The topic is *Nouvelles approches algorithmiques et bioinformatiques pour l'analyse des grandes masses de données issues des séquenceurs de nouvelle génération*.
- ANR France Génomique (2011-2014, PIA *Infrastructures Biologie Santé*). This national project involves 13 partners, including sequencing platforms and bioinformatics platform. We take part to the workpackage on sRNA-seq data analysis.

### 7.2.2. PEPS

- PEPS Biology-Mathematics-Computer science: “Etude comparative de l’architecture du génome mitochondrial chez les Caryophyllacées et les Poacées”. This project involves three partners: IBMP (Institut de Biologie Moléculaire des Plantes), GEPV (UMR CNRS 8198, Université Lille 1) and BONSAI.

### 7.2.3. ADT

- ADT biomanyocres (2010-2012): see section 5.8 .
- ADT biosciences resources (2011-2013): this ADT aims to build a portal of available applications in bioinformatics at Inria. The projects involves all the 8 teams from theme Bio-A and is more specifically developed by BONSAI and Rennes.

## 7.3. International Initiatives

- S. Blanquart pursues his collaboration with the Sterner Group of the “Institut für Biophysik und Physikalische Biochemie” (Regensburg, Germany) on an ancestral sequences resurrection project. Researchers of the Sterner Groups succeeded in the resurrection and characterization of the LUCA’s (Last Universal Common Ancestor) Histidine F enzyme, which have a TIM barrel fold. The paleo-enzyme works fine, just as do modern ones. It is the oldest resurrected yet proteins to our knowledge.
- In genomic rearrangement, we pursued our collaboration with the LaCIM at Université du Québec à Montréal, and DIRO at Université de Montréal. In the context of multiple genome comparison, we proposed a new framework for the multiple comparison of sets of transcripts transcribed from orthologous loci of several species [12].

## 7.4. International Research Visitors

### 7.4.1. Visits to International Teams

- A. Thomas, Univ. du Québec à Montréal (Canada), visit to Anne Bergeron (2 weeks),
- J.-S. Varré, Univ. du Québec à Montréal (Canada), visit to Anne Bergeron (1 week),
- A. Ouangraoua, Univ. du Québec à Montréal (Canada), visit to Anne Bergeron (4 months),
- M. Giraud, Univ. of Thessaloniki (Greece), visit to E. Cambouroupoulos (1 month).

## **DART Project-Team**

# **8. Partnerships and Cooperations**

## **8.1. European Initiatives**

### **8.1.1. Collaboration with Romania**

We collaborate with the University of Iași (Romania) on formal techniques for general and domain specific languages.

### **8.1.2. Collaboration with the Netherlands**

We collaborate with the Eindhoven University of Technology (The Netherlands) on formal techniques for general and domain specific languages.

## **8.2. International Research Visitors**

### **8.2.1. Visits of International Scientists**

Tim Willemse

Subject: visit to explore future collaborations.

Institution: Eindhoven University of Technology, NL

Duration: 1 week

Frank Stappers

Subject: formal verification for reconfigurable languages

Institution: Eindhoven University of Technology, NL

Duration: 6 weeks

#### **8.2.1.1. Internships**

Bram Gerron

Subject: formal verification of compilation

Institution: Eindhoven University of Technology, NL

Duration: 3 months

## **DOLPHIN Project-Team**

# **8. Partnerships and Cooperations**

## **8.1. Regional Initiatives**

- + PPF Bioinformatics: This program within the University of Lille 1 deals with solving bioinformatics and computational biology problems using combinatorial optimization techniques, 2010-2013.
- + PPF High Performance Computing, This program deals with parallel optimization, 2010-2013.
- + CIA (Campus Intelligence Ambiante) project from CPER (Contrat Plan Etat Région): Transversal research action: “High performance computing”, 2010-2013.

## **8.2. National Initiatives**

### **8.2.1. ANR**

- + ANR project Transports Terrestres Durable “RESPET - Gestion de réseaux de service porte-à-porte efficace pour le transport de marchandises”, in collaboration with LAAS (Toulouse), DHL, JASSP, LIA (Univ. Avignon) (2011-2014).
- + ANR project Modèles Numériques “NumBBO - Analysis, Improvement and Evaluation of Numerical Black-box Optimizers” (2012-2016) in collaboration with Inria Saclay, TAO team, Ecole des Mines de St. Etienne, CROCUS team, and TU Dortmund University, Germany (2012-2016).

## **8.3. European Initiatives**

### **8.3.1. FP7 Projects**

#### **8.3.2. Collaborations in European Programs, except FP7**

Program: COST

Project acronym: IC0804

Project title: Energy efficiency in large scale distributed systems

Duration: Jan 2009 - May 2013

Coordinator: J. M. Pierson

Other partners: More than 20 European countries.

Abstract: The COST Action IC0804 proposes realistic energy-efficient alternate solutions to share IT distributed resources. As large scale distributed systems gather and share more and more computing nodes and Storage resources, their energy consumption is exponentially increasing. While much effort is nowadays put into hardware specific solutions to lower energy consumptions, the need for a complementary approach is necessary at the distributed system level, i.e. middleware, network and applications. The Action characterizes the energy consumption and energy efficiencies of distributed applications.

#### **8.3.3. Collaborations with Major European Organizations**

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

University of Malaga: ETSI Informatica (Spain), “Parallel metaheuristics for dynamic optimization”

## 8.4. International Initiatives

### 8.4.1. Inria Associate Teams

#### 8.4.1.1. STEM

Title: deciSion Tools for Energy Management (STEM)

Inria principal investigator: L. Brotcorne

International Partners (Institution - Laboratory - Researcher):

Université de Montréal (Canada) - Département d'informatique et recherche opérationnelle  
- Francois Gilbert

Polytechnic School of Montreal (Canada) - Département de mathématique et génie industriel - Michel Gendreau

Duration: 2012 - 2014

See also: <http://dolphin.lille.inria.fr/Dolphin/STEM>

The economic rise of developing countries, together with the need to meet ever more stringent pollution reduction targets, will increase the stress on the global energy system. Within this framework, the goal of the current project is to develop decision tools for energy management in a context of market deregulation. We will focus on two issues, namely demand management and production planning.

The first problem is concerned with the efficient management of consumption. More precisely, the short or long term behaviour of customers can be influenced through signals sent by a utility (or several utilities) to the end-users. These signals can take the form of an "optimal" pricing scheme, or yet of devices (timers, automatic switches, etc.) designed to induce an "optimal" behaviour from the users.

The second issue is concerned with efficient management of sustainable energy production. Indeed the development of renewable energy introduces new parameters in the supply/demand global equilibrium process. The issue is to achieve the right trade-off between costs (production, security) and revenues when determining the daily hydro-electricity generation and storage within an environment where demand is stochastic.

The first problem is modeled as a bilevel program, the second one as a integer multi-objective stochastic program. Efficient and effective solution methods are developed and implemented to solve these problems.

### 8.4.2. Inria International Partners

- University of Sydney, Australia
- University of Montreal and Ecole Polytechnique of Montreal, Canada
- University of Dortmund, Germany
- ETH Zurich, Switzerland
- SINTEF, Norway

### 8.4.3. Participation In International Programs

- Inria STIC-Tunisie, 2011-2013.
- Inria STIC-Algérie, 2011-2013.
- CNRS PICS Luxembourg, 2011-2014.

## 8.5. International Research Visitors

### 8.5.1. Visits of International Scientists

The project had visitors during the year 2010:



- Prof. Michel Gendreau, University of Montreal
- Prof. Pascal Bouvry, University of Luxembourg
- Dr. Gleb Belov, Univ. Essen, Germany
- Dr. Manuel Lopez-Ibanez, IRIDIA, Université Libre de Bruxelles, Belgium,
- Dr. Boris Naujoks, Cologne University of Applied Sciences, Gummersbach, Germany
- Prof. Gunter Rudolph, TU Dortmund University, Germany

### **8.5.2. Visits to International Teams**

- D. Brockhoff, June 2012, TU Dortmund University, Germany
- D. Brockhoff, March 2012, ETH Zurich, Switzerland
- E-G. Talbi, Dec 2012, Univ. Luxembourg, Luxembourg
- A. Liefoghe, jan 2012, University of Malaga, Spain

## FUN Team

# 7. Partnerships and Cooperations

## 7.1. International Initiatives

Tahiry Razafindralambo is researcher on leave at Inria Chile from Sept. 2012 to Aug. 2013 investigating *Integration of wireless sensor network deployed in mines into the Internet*.

## 7.2. Regional Initiatives

### 7.2.1. DECARTE

**Participants:** Nathalie Mitton [correspondant], David Simplot-Ryl.

Title: Developpement de Carton électronique

Type: FUI

Duration: November 2008 - Avril 2013

Coordinator: Cartonneries de Gondardennes

Others partners: Inria FUN IEMN CTP Cascades IER TagSys

Abstract: DECARTE studies the printing of an UHF RFID tag on packaging in order to reduce manufacturing costs.

### 7.2.2. Tracaverre

**Participant:** Nathalie Mitton [correspondant].

Title: Tracaverre

Type: FUI

Duration: November 2012 - Avril 2015

Coordinator: Saver Glass

Others partners: Inria FUN IEMN Courbon Camus La Grande Marque LIRIS DISP

Abstract: \_\_\_Tracaverre studies the use of RFID for traceability of prestigious bottles.\_\_\_

### 7.2.3. IDC

**Participants:** Roudy Dagher, Nathalie Mitton [correspondant], David Simplot-Ryl.

Title: Intelligent Data Center

Type: IPER

Duration: November 2010 - June 2012

Coordinator: NooliTic

Others partners: Inria FUN CIV

Abstract: \_\_\_IDC studies wireless sensor network based solution to optimize the server monitoring in data centers. \_\_\_

## 7.3. National Initiatives

### 7.3.1. ANR

#### 7.3.1.1. RESCUE

**Participants:** Milan Erdelj, Nathalie Mitton, Kalypso Magklara, Karen Miranda, Tahiry Razafindralambo [correspondant].

Title: Reseau Coordonne de substitution mobile

Type: VERSO

Duration: December 2010 - December 2013

Coordinator: Inria FUN

Other partners: LAAS UPMC France Telecom ENS Lyon

See also: <http://rescue.lille.inria.fr/>

Abstract: In RESCUE, we propose to exploit the controlled mobility of mobile routers to help a base network in trouble provide a better service. The base network may be any access network or metropolitan network (including wired and wireless technologies). Troubles may come from an increase of unplanned traffic, a failure of an equipment, or a power outage.

When no backup networks are available, it would be interesting to deploy, for a limited time corresponding to the period of the problem (i.e., failure or traffic overload), a substitution network to help the base network keep providing services to users. In the RESCUE project, we will investigate both the underlying mechanisms and the deployment of a substitution network composed of a fleet of dirigible wireless mobile routers. Unlike many projects and other scientific works that consider mobility as a drawback, in RESCUE we use the controlled mobility of the substitution network to help the base network reduce contention or to create an alternative network in case of failure.

#### 7.3.1.2. WINGS

**Participants:** Nathalie Mitton [correspondant], Roberto Quilez, David Simplot-Ryl.

Title: Widening Interoperability for Networking Global Supply Chains

Type: VERSO

Duration: November 2009 - March 2012

Coordinator: GS1

Other partners: Inria FUN UPMC France Telecom AFNIC GREYC

See also: <http://www.wings-project.fr/>

Abstract: This 2-year project focus on a proof-of-concept platform demonstrating the federated ONS model and the interaction with a prototype of Discovery Service.

#### 7.3.1.3. F-Lab

**Participants:** Nathalie Mitton [correspondant], Priyanka Rawat, Tahiry Razafindralambo.

Title: Federating Computing Resources

Type: VERSO

Duration: November 2010 - November 2013

Coordinator: UPMC

Other partners: Inria DNet, Planete, FUN Thales ALU

See also: <http://f-lab.fr/>

Abstract: The F-Lab project works towards enabling an open, general-purpose and sustainable large-scale shared experimental facility that fosters the emergence of the Future Internet. F-Lab builds on a leading prototype for such a facility: the OneLab federation of testbeds. F-Lab will enhance the OneLab federation model with the addition of SensLAB's unique sensor network and LTE-based cellular systems, and develop tools to conduct experiments on these enriched facilities. Project partners include some of France's top academic and industrial research institutions, working together to develop experimental facilities on the Future Internet. F-Lab presents an unique opportunity for the French community to play a stronger role in the design of federation systems; for the SensLAB testbed to reach an international visibility and use; and for the pioneering of testbeds based on LTE technology.

#### 7.3.1.4. BinThatThinks

**Participants:** Tony Ducrocq, Nathalie Mitton [correspondant].

Title: BinThatThinks

Type: ECOTECH

Duration: November 2010 - November 2013

Coordinator: Inria ACES (Rennes)

Other partners: Etineo Veolia

See also: \_\_\_ <http://binthatthink.inria.fr/> \_\_\_

Abstract: \_\_\_ Efficient dust sorting is a main challenge for the current society. BinThatThinks is a research project that aims to propose a system that makes the collect and sorting easier through the use of RFID and sensors. \_\_\_

### 7.3.2. ADT

#### 7.3.2.1. SenSas

**Participants:** Nathalie Mitton [correspondant], Lucie Jacquelin, Tahiry Razafindralambo, Julien Vandaele.

Title: Sensor Network Applications (SensAS)

Type: ADT

Duration: November 2010 - November 2014

Coordinator: Inria D-NET

Others partners: Inria Non-A Inria Planete Inria NECS Inria DEMAR Inria MADYNES Inria AMAZONE Inria SED

See also: \_\_\_ <http://sensas.gforge.inria.fr/> \_\_\_

Abstract: \_\_\_ Sensas aims to propose mainly control science application based on wireless sensor and actuator network nodes provided from the work done around senslab and sensstools projects. \_\_\_

#### 7.3.2.2. SensLille

**Participants:** Victor Corblin, Khalil Hammami, Nathalie Mitton [correspondant], Loic Schmidt, Julien Vandaele.

Title: SensLille

Type: ADT

Duration: November 2011 - November 2013

Coordinator: Inria FUN

Abstract: \_\_\_ SensLille is an ADT that aims to improve SensLab Lille platform by offering new functionalities as the use of electric trains to experiment mobile nodes. \_\_\_

#### 7.3.2.3. MiAOU

**Participants:** Ibrahim Amadou, Rim Driss, Nathalie Mitton [correspondant], Loic Schmidt, Julien Vandaele.

Title: Middleware Application to Optimal Use (MiAOU)

Type: ADT

Duration: December 2012 - November 2014

Coordinator: Inria FUN

Abstract: \_\_\_ Miaou is an ADT that aims to promote the AspireRFID middleware to a new level of manageability and usability. \_\_\_

### 7.3.3. Equipements d'Excellence

#### 7.3.3.1. FIT

**Participants:** Nathalie Mitton [correspondant], Anne-Sophie Tonneau, Tahiry Razafindralambo, Loic Schmidt, David Simplot-Ryl, Julien Vandaele.

Title: Future Internet of Things

Type: EquipEx

Duration: March 2010 - December 2019

Coordinator: UPMC

See also: \_\_\_ <http://fit-equipex.fr/> \_\_\_

Abstract: \_\_\_FIT (Future Internet of Things) aims to develop an experimental facility, a federated and competitive infrastructure with international visibility and a broad panel of customers. It will provide this facility with a set of complementary components that enable experimentation on innovative services for academic and industrial users. The project will give French Internet stakeholders a means to experiment on mobile wireless communications at the network and application layers thereby accelerating the design of advanced networking technologies for the Future Internet.

FIT is one of 52 winning projects from the first wave of the French Ministry of Higher Education and Research's "Equipements d'Excellence" (Equipex) research grant program. Coordinated by Professor Serge Fdida of UPMC Sorbonne Universités and running over a nine-year period, the project will benefit from a 5.8 million euro grant from the French government. \_\_\_

## 7.4. European Initiatives

### 7.4.1. Collaborations in European Programs, except FP7

Program: ICT Labs

Project acronym: FiTTING

Project title: FiTTING

Duration: January 2012 - December 2012

Coordinator: UPMC

Other partners: Inria, IBBT, Fraunhofer, University of Budapest

Abstract: The FiTTING facility is about developing the tools needed to create the Future Internet of Things. The experimenters (both academic and industrial) who are developing this new technology require access to experimental platforms (testbeds) where they can try out their ideas before releasing them to the general public. FiTTING facilitates their innovation by federating Europe's next-generation testbeds.

## 7.5. International Initiatives

### 7.5.1. Participation In International Programs

Program: CoperLink

Project acronym: Palmares

Project title: Palmares

Duration: January 2012 - April 2013

Coordinator: Università degli Studi Mediterranea, Italy

Other partners: Inria, Stellenbosch University (South Africa)

Abstract: Internet of things, VANET and substitution networks.

## 7.6. International Research Visitors

### 7.6.1. Visits of International Scientists

Oswald Jumira (from June 2012 until July 2012)

Institution: Stellenbosch University (South Africa)

Essia Hamouda (from June 2012 until July 2012)

Institution: University of Riverside (USA)

Danping He (from August 2012 until October 2012)

Subject: Range and frequency adaptation in neighbor discovery in mobile wireless networks.

Institution: Universidad de Madrid (Spain)

Pr Ian Akyiliz (July 2012)

Institution: GeorgiaTech (USA)

#### 7.6.1.1. Internships

Natale GUZZO (from May 2012 until Oct 2012)

Subject: Quality of Service and Energy Efficiency in Wireless Networks

Institution: Universita di Roma La Sapienza (Italy)

Kalypso Magklara (from Apr 2012 until Sep 2012)

Subject: Pickup and delivery problems in wireless sensor and actuator networks

Institution: University of Piraeus (Greece)

Jaco Du Toit (from Sept 2012 to Jan 2013)

Subject: Application of the Principles of Erasure Resilient Channel Coding Strategies in Distributed Wireless Network Environments

Institution: Stellenbosch University (South Africa)

Johan Pieterse (from Sept 2012 to Jan 2013)

Subject: Investigation of Handover Techniques in a IPv6 Mobile Wireless Network

Institution: Stellenbosch University (South Africa)

Rim Driss (from Apr 2012 to Sept 2012)

Subject: Analysis of the impact of error on geographic positions in neighbor discovery in wireless networks.

Institution: Université de Sfax (Tunisia)

### 7.6.2. Visits to International Teams

- Tahiry Razafindralambo is made available from Sept 1st 2012 to Aug 21 2013 at Universidad de Santiago, Chili.
- Nathalie Mitton visited for 2 weeks Stellebosch University (Aug-Sept 2012) in South Africa.

## MINT Project-Team

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

MINT is associated to the CPER (2007-2013), and participates to the PIRVI platform (handled by F. Aubert, co-animated by F. Aubert and D. Marchal), which aims at promoting research achieved by participant research teams (6 research teams, among which MINT), as well as encouraging collaborations with regional economical tissue on the knowledge fields covered within the associated research teams. This dissemination activity has been supported with a regional contract 500 Keuros.

## 8.2. National Initiatives

### 8.2.1. *InSTInCT (ANR ContInt, 2009-2012)*

**Participants:** Géry Casiez [correspondant], Frédéric Giraud, Laurent Grisoni, Nicolas Roussel.

This project focuses on the design, development and evaluation of new simple and efficient touch-based interfaces, with the goal of bringing widespread visibility to new generations of interactive 3D applications.

Partners: Inria [Mint, Iparla], Immersion, Cap Sciences

Web site: <http://anr-instinct.cap-sciences.net/>

### 8.2.2. *TOUCHIT (13th FUI, 2012-2015)*

**Participants:** Michel Amberg, Géry Casiez, Frédéric Giraud, Thomas Pietrzak, Nicolas Roussel [correspondant], Betty Lemaire-Semail [correspondant].

The purpose of this project is twofold. It aims at designing and implementing hardware solutions for tactile feedback based on programmable friction. It also aims at developing the knowledge and software tools required to use these new technologies for human-computer interaction. Grant for MINT is balanced on 272 keuro handled at University for L2EP, and 220 Keuros for Inria.

Partners: STMicroelectronics, CEA/LETI, Lille 1 Univ., Inria, Orange Labs, CNRS, EASii IC, MENAPIC and ALPHAUI.

Competitive clusters involved: **Minalogic**, **Cap Digital** and **MAUD**.

### 8.2.3. *Smart-Store (12th FUI, 2011-2014, extended to 2015)*

**Participants:** Samuel Degrande [correspondant], Laurent Grisoni, Fabrice Aubert.

The aim of this project is to set up, in the context of retail, some middleware and hardware setup for retail interactive terminal, that allows customer to connect with their own smart-phone on a system that includes a large screen, and allows to browse some store offer, as well as pre-order and/or link to further reconsulting. SME Idées-3com leads this FUI, which also includes Immochan, Oxylane, and VisioNord. Grant for MINT is 301 Keuros. This project start on september 2012 (start of this project has been delayed due to administrative problems), for a duration of 36 months.

associated competitiveness cluster: PICOM (retail)

## 8.3. European Initiatives

### 8.3.1. *Sm(art)<sup>2</sup>*

**Participants:** Laurent Grisoni [correspondant], Betty Lemaire-Semail, Frédéric Giraud, Géry Casiez.

We submitted in april 2012 the IP proposal Sm(art)<sup>2</sup> on the call 9, priority 8.2 "ICT for access to cultural ressources". Laurent Grisoni is the scientific coordinator of this proposal. It includes 25 partners, with a global budget of 10 489 Keuros. This proposal ranks 4th on the call among 40 submissions, three proposals are currently in the negotiation phasis. Our proposal is currently ranking first on the additionnal list.

Program: FP7-ICT-2011-9

Project acronym: Sm(art)<sup>2</sup>

Project title: Smart art: smart tools for personnalised and engaging experiences in cultural heritage

Duration: 48 months

Coordinator: L. Grisoni

Other partners: organisme, labo (pays): Musee du louvres-lens (france), Fraunhoffer (germany), CNRS (france), University Hasselt (belgium), Softkinetic (Belgium), immersion (france), InescID (portugal), France Telecom (france), ...

Abstract: Sm(art)<sup>2</sup> project is based on the extended model of museum visit concept (pre-, during and post experience) combining physical and online museum and addresses visitors as participants rather than passive consumers. The next generation of museum practitioners will have to think through these challenges carefully, drawing the links more closely between the physical and the virtual so that the museum create more engaging and personalizing experiences and reaches more people meaningfully. The Sm(art)<sup>2</sup> project aims to implement an interoperable platform with a reusable set of tools and compatible equipment for advanced innovative digital technologies that are able to demonstrate enhanced engaging and personalized experiences of cultural heritage in museums. Moreover the development of economic models for the efficient and legal exploitation of high quality content and technologies will permit the implementation of new services related to the cultural heritage and the use of new technologies.

### 8.3.2. SHIVA (*InterReg II-Seas, 2010-2014*)

**Participants:** Fabrice Aubert, Géry Casiez, Samuel Degrande, Laurent Grisoni [correspondant], Damien Marchal, Yosra Rekik, Nicolas Roussel.

Program: Interreg-II seas IV-A

Project acronym: SHIVA

Project title: Sculpture for Haelth-care: Interaction and Virtual Art in 3D

Duration: february 2010-march 2014

Coordinator: L. Grisoni

Other partners: organisme, labo (pays) : University Bournemouht (UK), Victoria education center (Poole, UK), Fondation Hopale (Berck/mer, France)

Abstract: The SHIVA project aims to create a tool that combines virtual reality, advanced geometric modelling, gesture analysis and digital fabrication in a framework for the modelling and physical fabrication of 3-dimensional shapes and objects. The system will be simple to use and disseminate, specifically enabling and improving the quality of life for individuals with impairments, by facilitating and promoting social inclusion and interaction. It will use, provided that patient pathologies allows for it, hands-free interaction, based on currently available hardware systems. Some of the most complex aspects of the system will be transparent to the user or patient. This will enable individuals with or without impairments who use the system to be able to interact with and model 3-dimensional objects that can then be physically manufactured. A set of specific interfaces will also be implemented for children with very low physical abilities (two-states interfaces for example).

Web site: <http://www.lifl.fr/mint/pmwiki.php?n=SHIVA.Php>



## **8.4. International Research Visitors**

### **8.4.1. Visits of International Scientists**

Masaya Takasaki (from March 2012 until July 2012)

Subject: Design of transparent tactile displays

Institution: Saitama University (Japan)

### **8.4.2. Internships**

Yy Yang (from May 2012 until Aug 2012)

Subject: Design and control of large tactile feedback device

Institution: Beihang University of Aeronautics and Astronautics (China)

### **8.4.3. Visits to International Teams**

Frédéric Giraud, Sept 2012–Aug 2013, University of Toronto: Invited professor in the Energy System Group hosted by the department of Electrical and Computer Engineering.

## MODAL Project-Team

## 8. Partnerships and Cooperations

### 8.1. Regional Initiatives

#### 8.1.1. *Institut de Biologie de Lille, Génomique et Maladies Métaboliques lab*

**Participants:** Christophe Biernacki, Julien Jacques, Loic Yengo.

#### 8.1.2. *Industrial Studies Center, Arcelor-Mittal*

**Participants:** Clément Thery, Christophe Biernacki.

#### 8.1.3. *Gene Diffusion*

**Participants:** Julien Jacques, Julie Hamon.

#### 8.1.4. *Institut Pasteur Lille and Institut de Biologie de Lille*

**Participant:** Guillemette Marot.

- Team "Etudes Transcriptomiques et Génomiques Appliquées"n (D. Hot).
- Team "Peste et Yersinia pestis", (F. Sebbane).
- team "Unité d'approches fonctionnelle et structurale des cancers", O. Pluquet.

#### 8.1.5. *Université de Lille 2*

**Participant:** Guillemette Marot.

Plate-forme de génomique fonctionnelle et Structurale, (M. Figeac)

#### 8.1.6. *CHRU Lille*

**Participant:** Guillemette Marot.

Centre de Biologie Pathologie, Laboratoire d'Hématologie, (C. Preudhomme)

#### 8.1.7. *ASEL and CRESGE*

**Participant:** Cristian Preda.

ASEL (Association Septentrionale pour l'Etude de Lymphomes) and CRESGE (Centre de Recherches Economiques Sociologiques et de Gestion) from Lille

### 8.2. National Initiatives

#### 8.2.1. *StatLearn'12*

Christophe Biernacki, Alain Ceélisse, Serge Iovleff and Julien Jacques co-organized with Charles Bouveyron (University Paris 1, SAMM) a workshop on "Challenging problems in Statistical Learning", StatLearn'12, in April 2012 in Lille (<http://www.inria.fr/en/centre/lille/calendar/workshop-statlearn-12>). There were about 80 applicants, 12 one-hour invited talk organized in four sessions: Statistical learning and vizualization, Statistical learning in high dimension, Statistical learning and structured data, New and future problems in statistical learning.

#### 8.2.2. *StatOmique*

Guillemette Marot belongs to the StatOmique working group <http://vim-iip.jouy.inra.fr:8080/statomique/>

### **8.3. European Initiatives**

#### **8.3.1. *University of Granada, Department of Statistics and Operational Research***

**Participant:** Cristian Preda.

Collaboration with Professor Ana Aguilera : teaching at Master and Doctoral level, joint research, ERASMUS mobility and conference organization.

### **8.4. International Research Visitors**

#### **8.4.1. *Nanyang Technology University of Singapore***

**Participant:** Cristian Preda.

Collaboration with Professor Lian Heng on functional regression models : joint research.

Cristian Preda was invited at NTU from December 3th to December 15th 2012.

## MOSTRARE Project-Team

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

### 8.1.1. *Thèse Inria-Région NPdC (2012-2015)*

**Participants:** David Chatel, Pascal Denis, Marc Tommasi [correspondent].

Denis and Tommasi supervise the PhD thesis of David Chatel on guided clustering. The PhD is funded by INRIA and the “région Nord - Pas de Calais”.

## 8.2. National Initiatives

### 8.2.1. ANR

#### 8.2.1.1. *ANR Lampada (2009-2014)*

**Participants:** Marc Tommasi [correspondent], Rémi Gilleron, Aurélien Lemay, Fabien Torre, Gemma Garriga.

The Lampada project on “Learning Algorithms, Models and sPArse representations for structured DAta” is coordinated by Tommasi from Mostrare. Our partners are the SEQUEL project of Inria Lille Nord Europe, the LIF (Marseille), the HUBERT CURIEN laboratory (Saint-Etienne), and LIP6 (Paris). More information on the project can be found on <http://lampada.gforge.inria.fr/>.

#### 8.2.1.2. *ANR Defis Codex (2009-2012)*

**Participants:** Joachim Niehren [correspondent], Sławek Staworko, Aurélien Lemay, Sophie Tison, Anne-Cécile Caron, Jérôme Champavère.

The Codex project on “Efficiency, Dynamicity and Composition for XML Models, Algorithms, and Systems” and is coordinated by Manolescu (GEMO, Inria Saclay). The other partners of Mostrare there are Geneves (WAM, Inria Grenoble), COLAZZO (LRI, Orsay), Castagna (PPS, Paris 7), and Halfeld (Blois). Public information on Codex can be found on <http://codex.saclay.inria.fr/>.

### 8.2.2. *Competitivity Clusters*

#### 8.2.2.1. *FUI Hermes (2012-2015)*

Joint project in collaboration with many companies (Auchan, KeyneSoft, Cylande, ...). The main objective is to develop a platform for contextual customer relation management. The project started in November 2012.

## 8.3. European Initiatives

### 8.3.1. *Collaborations in European Programs, except FP7*

MOSTRARE, in collaboration with SEQUEL and Rouen, is part of the Inria Lille - Nord Europe site for the European Network of Excellence in Pattern Analysis, Statistical Modelling and Computational Learning (PASCAL2).

### 8.3.2. *Collaborations with Major European Organizations*

Publications [29] and [20] are results of collaborations with the University of Wroclaw and the University of Oxford respectively.

## 8.4. International Initiatives

### 8.4.1. Inria International Partners

The ongoing cooperation with our previous international partner at NICTA Sydney has led to a publication at PODS'2012 [26].

## 8.5. International Research Visitors

### 8.5.1. Visits of International Scientists

Jan van den Bussche from the University of Hasselt and Werner Nutt from the University of Bolzano visited Bonifati and Niehren for a recent cooperation.

Fabien Suchanek from the Max-Planck Institute in Saarbrücken visited Bonifati and Niehren and presented his work in the Mostrare seminar.

Yannis Valegrakis from the University of Trento visited Bonifati and presented his work in the Mostrare seminar.

George Fletcher and Toon Calders from the University of Eindhoven visited Bonifati and Staworko and presented their work in the Mostrare seminar.

#### 8.5.1.1. Internships

Carles Creus from the University of Barcelona visited Boiret, Lemay, and Niehren for 4 months for working on tree transducers and compression.

Pavel Labath from the University of Bratislava visited Debarbieux, Sebastian, and Niehren for working on streaming algorithms for XSLT.

### 8.5.2. Visits to International Teams

Staworko visited Gabriele Papis and Cristian Riverson at the University of Oxford [28].

Niehren visited Mikael Benedikt, Georg Gottlob, and Marta Kwiatkowska at the University of Oxford.

Staworko visited Piotr Wiecek at the University of Warsaw [29].

Groz left for postdoc to the database group of Tova Milo at the University of Haifa in Israel.

## NON-A Project-Team

## 7. Partnerships and Cooperations

### 7.1. National Initiatives

- We are involved in several technical groups of the GDR MACS (CNRS, "Modélisation, Analyse de Conduite des Systèmes dynamiques", see <http://www.univ-valenciennes.fr/GDR-MACS>), in particular: Technical Groups "Identification", "Time Delay Systems", "Hybrid Systems" and "Control in Electrical Engineering".
- Model-free control: collaborations with Professor Brigitte D'Andréa-Novel at Mines ParisTech and Professor Emmanuel Delaleau at ENIB (Brest).
- Atomic Force Microscope (AFM): application of new algebraic methods in tapping mode for AFM, collaboration with the National Laboratory of Metrology (LNE) located at Trappes.

### 7.2. European Initiatives

- Collaboration with Sarah Spurgeon of University of Kent on Sliding mode control;
- Collaboration with Emmanuel Brousseau of Cardiff University for the project: "on nano mechanical machining of 3D nano structures by AFM".

### 7.3. International Initiatives

- Collaboration with Professors Tulay Adali (University of Baltimore, USA) and Daniel Alpay (University of Ben Gurion, Israel) on signal processing.
- Collaboration with Professors Emilia Fridman (Tel Aviv University) and Joao Manoel Gomes da Silva (UFRGS, Porto Alegre, Brasil) on time-delay systems.
- Collaborations with Professor Guiseppe Fedele from University of Calabria, Italy, on "Model-free control".
- Programme Hubert Curien GALILEE for scientific exchange between LAGIS and University of Cagliari, Italy;
- Programme Hubert Curien VOLUBILIS (Maroc, Integrated Action MA/09/211) between LAGIS (Université Lille1), Non-A/Inria and Laboratory of Electronic, Information and Biotechnology of Department of Science at University Moulay Ismail of Meknès;
- Programme Hubert Curien COGITO for scientific exchange between University of Reims Champagne Ardenne, Non-A and University of Zagreb.
- Collaboration and scientific exchanges with Saint-Petersburg National Research University ITMO, Russia, on interval estimation of linear-parameter-varying systems and on spark ignition engine control.
- Collaboration and scientific exchanges with Universidad Nacional Autónoma de México (UNAM) (Prof. L. Fridman) and Autonomous University of Nuevo Leon (Prof. M. Basin), Mexico, on estimation of linear-parameter-varying systems and sliding-mode control.

### 7.4. International Research Visitors

#### 7.4.1. Visits of international scientists

- Emilia Fridman, Professor of Tel Aviv University, Israel, June 2012, supported by École Centrale de Lille;

- Marc Bodson, Professor of University of Utah, USA, June 2012, supported by École Centrale de Lille;
- Michael Basin, Professor of Autonomous University of Nuevo Leon, Mexico, June 2012, supported by a bilateral CNRS project.
- Hebertt Sira Ramírez, Professor of CINVESTAV IPN, Mexico, November 2012, supported by École Centrale de Lille.

#### **7.4.2. Internships**

- Stanislav Chebotarev, PhD student of National Research University ITMO, Russia, June 2012, "Interval estimation of LPV systems", supported by ITMO;
- Hector Rios, PhD student of UNAM, Mexico, September–November 2012, "Discrete state estimation for switched LPV systems", supported by UNAM.

## RMOD Project-Team

# 7. Partnerships and Cooperations

## 7.1. Regional Initiatives

We have signed a convention with the CAR team led by Noury Bouraqadi of École des Mines de Douai. In such context we co-supervised two PhD students (Mariano Martinez-Peck and Nick Papoylias). The team is also an important contributor and supporting organization of the Pharo project.

## 7.2. National Initiatives

### 7.2.1. ANR

#### 7.2.1.1. Cutter

**Participants:** Stéphane Ducasse [Correspondant], Nicolas Anquetil, Damien Pollet, Muhammad Bhatti, Andre Hora.

This partnership is done with the following members from the LIRMM-D'OC-APR: Marianne Huchard, Roland Ducournau, Jean-Claude König, Rodokphe Giroudeau, Abdelhak-Djamel Seriai, and Rémi Watrigant.

CUTTER is a Basic Research project that addresses the problems of object-oriented system (re-)modularization by developing, combining, and evaluating new techniques for analyzing and modularizing code. In particular, it will: (i) use concurrently and collaboratively four package decomposition techniques; and (ii) take into account different levels of abstractions (packages, classes).

## 7.3. European Initiatives

**Participants:** Stéphane Ducasse [correspondant], Veronica Uquillas-Gomez, Marcus Denker.

### 7.3.1. IAP MoVES

**Participant:** Stéphane Ducasse [correspondant].

The Belgium IAP (Interuniversity Attraction Poles) MoVES (Fundamental Issues in Software Engineering: Modeling, Verification and Evolution of Software) is a project whose partners are the Belgium universities (VUB, KUL, UA, UCB, ULB, FUNDP, ULg, UMH) and three European institutes (Inria, IC and TUD) respectively from France, Great Britain and Netherlands. This consortium combines the leading Belgian research teams and their neighbors in software engineering, with recognized scientific excellence in MDE, software evolution, formal modeling and verification, and AOSD. The project focusses on the development, integration and extension of state-of-the-art languages, formalisms and techniques for modeling and verifying dependable software systems and supporting the evolution of Software-intensive systems. The project has started in January 2007 and is scheduled for a 60-months period. Read more at <http://moves.vub.ac.be>.

### 7.3.2. ERCIM Software Evolution

We are involved in the ERCIM Software Evolution working group since its inception. We participated at his creation when we were at the University of Bern.



## 7.4. International Initiatives

### 7.4.1. Inria Associate Teams

#### 7.4.1.1. PLOMO

Title: Customizable Tools and Infrastructure for Software Development and Maintenance

Inria principal investigator: Stéphane Ducasse

International Partner (Institution - Laboratory - Researcher):

University of Chile (Chile) - PLEIAD

Duration: 2011–2013

See also: <http://pleiad.dcc.uchile.cl/research/plomo>

#### Project Description

Software maintenance is the process of maintaining a software system by removing bugs, fixing performance issues and adapting it to keep it useful and competitive in an ever-changing environment [32]. Performing effective software maintenance and development is best achieved with effective tool support, provided by a variety of tools, each one presenting a specific kind of information supporting the task at hand [34]. The goal of PLOMO is to develop new meta tools to improve and bring synergy in the existing infrastructure of Pharo (for software development) and the Moose software analysis platform (for software maintenance).

PLOMO will (1) enhance the Opal open compiler infrastructure to support plugin definition, (2) offer an infrastructure for change and event tracking as well as model to compose and manipulate them, (3) work on a layered library of algorithms for the Mondrian visualization engine of Moose, (4) work on new ways of profiling applications. All the efforts will be performed on Pharo and Moose, two platforms heavily used by the RMoD and PLEIAD team.

The outcomes of PLOMO will include new research advances in the field of (i) bytecode generation for dynamic language; (ii) change and event tracking; (iii) software visualization engine; (iv) agile profiling framework. These four topics are recurrently considered by the most prestigious and competitive conferences (e.g., ECOOP, OOPSLA, FSE, ESEC, ICSE, TOOLS) and journals (e.g., TSE, TOPLAS, ASE), to which the participants of the PLOMO project are used to publish.

A strong focus on publishing our results in relevant scientific forum will remain a top priority. The artifacts produced by PLOMO will strongly reinforce the Pharo programming language and the Moose software analysis platform. The development and progress of Pharo is structured by RMoD, which has successfully created a strong and dynamic community. Moose is being used to realize consulting activities and it is used as a research platform in about 10 Universities, worldwide. We expect PLOMO to have a strong impact in both the software products and the communities structured around them.

#### Research Visits to Chile

- Benjamin van Ryseghem from May 28th until June 16th, 2012.
- Damien Pollet from November 1st until November 30th, 2012.
- Marcus Denker from November 5th until November 22nd, 2012

#### Recent Results

In the second year of execution of Plomo, work has focused on:

- Rizel: a performance evolution monitor.
- A book chapter on Roassal in the book Pharo By Example 2
- Roassal also won the third place award in the ESUG 2012 innovation technology awards.
- Athens, the graphic rendering engine developed by RMoD, is used by Roassal.
- Starting of the founding process of Synectique, a company based in Lille that offers solutions based on the Moose platform. ObjectProfile offers to Synectique a dedicated support of Roassal.

- Integration of profiling techniques into Jenkins, the continuous integration server used for Pharo. We expect to have a massive amount of profiling information.
- Opal debugging and development continued. The bytecode backend is ready for integration in Pharo 2.0.
- Gradualtalk: a gradually typed Smalltalk, built on Opal, has been implemented. It allows code in Pharo to be gradually and optionally typed.
- The Announcements framework to enable change and event tracking.
- Spec: a Framework for the Specification and Reuse of UIs and their Models. It uses the Announcements framework to enable fine-grained UI refreshes. Roassal makes use of Spec for its component
- Work on the DIE domain-specific language and the definition of IDE plugins using it, as well as work on change prediction models are still ongoing.

#### Supervised PhD students

- Vanessa Peña, PhD student Universidad de Chile. She is working on test coverage and domain specific analyses
- Juan Pablo Sandoval, PhD student Universidad de Chile.

#### Companies Using our Results

- Synectique is a company delivering dedicated software analysis. Synectique uses Roassal to visually report the analysis of customer source code. The founding process started in 2012, and is expected to be finished in 2013.
- ObjectProfile was founded in 2011 in Chile. Its business plan is essentially focused on Pharo and Roassal. Object Profile offers support of its products to RMoD and Synectique. A number of features of Roassal have been designed to meet Synectique's requirements (e.g., the navigation and scrolling options).

#### Publications

- Benjamin Van Ryseghem, Stéphane Ducasse, Johan Fabry, Spec: a Framework for the Specification and Reuse of UIs and their Models, in Proceedings of the 4th International Workshop on Smalltalk Technologies (IWST'12), Collocated with ESUG, August 2012. ACM Digital Library (To Appear). [20]
- Juan Pablo Sandoval, Tracking Down Software Changes Responsible for Performance Loss, in Proceedings of the 4th International Workshop on Smalltalk Technologies (IWST'12), Collocated with ESUG, August 2012. ACM Digital Library (To Appear)

### 7.4.2. Participation In International Programs

#### 7.4.2.1. Project Pequi – Inria/CNPq Brésil

The Pequi project is a collaboration between Professor Marco T. Valente's team at the Federal University of Minas Gerais in Brazil and the RMoD team. It focuses in producing Metrics, Techniques, and Tools for Software Remodularization.

It is recognized that software systems must be continuously maintained and evolved to remain useful. However, ongoing maintenance over the years contributes to degrade the quality of a system. Thus reengineering activities, including remodularization activities, are necessary to restore or enhance the maintainability of the systems. To help in the remodularization of software systems, the project will be structured in two main research lines in which both teams have experience and participation: (i) Evaluation and Characterization of Metrics for Software Remodularization; and (ii) Tools and Techniques for Removal of Architectural Violations.

The project started in July 2011 with a visit of Dr. Nicolas Anquetil to the brazilian team. The project will last 24 months.

### Research Visits

- Nicolas Anquetil, from August 6th to 11th.
- Andre Hora, from November 26th to January 4th.

### 7.4.3. Others

We are building an ecosystem around Pharo with international research groups, universities and companies. Several research groups (such as Software Composition Group – Bern, and Pleaid – Santiago) are using Pharo. Many universities are teaching OOP using Pharo and its books. Several companies worldwide are deploying business solutions using Pharo.

## 7.5. International Research Visitors

### 7.5.1. Visits of International Scientists

In the context of the PLOMO associated Team with the University of Chile:

- Johan Fabry from March 19th until March 23rd, 2012
- Johan Fabry from August 17th until Sept 2nd, 2012.
- Juan Pablo Sandoval from 9 November until 2 December 2012. The topic of the research visit is monitoring of performance evolution.

In the context of the Pequi project associated Team with the Federal University of Minas Gerais:

- Professor Marco Tulio Valente visited from February 7th to 13th.
- Ricardo Terra PhD student visited us for one week in beginning of April 2012.

Other visits of international scientists:

- Fernando Olivero, PhD Student from the University of Lugano, Switzerland, visited RMoD in March 2012.
- Jurgen VinJu, group leader of SEN1 - Software Analysis & Transformation at CWI, visited us on May 10th and 11th.

#### 7.5.1.1. Internships

Ezequiel La Mónica (from Apr 2012 until Jun 2012)

Subject: Rule checking for pharo

Institution: University of Buenos Aires (Argentina)

Cesar Couto (from December 2011 until February 2012)

Subject: Uncovering Causal Relationships between Software Metrics and Bugs

Institution: Federal University of Minas Gerais, Brazil

### 7.5.2. Visits to International Teams

In the context of the PLOMO associated Team with the University of Chile:

- Marcus Denker from January 17th to February 1st.
- Benjamin van Ryseghem from May 28th to June 16th.
- Damien Pollet from October 31st to November 13th.
- Marcus Denker from November 5th to November 22nd.

In the context of the Pequi project associated Team with the Federal University of Minas Gerais:

- Nicolas Anquetil, from August 4th to 19th.
- Andre Hora, from November 26th to January 4th.

Many RMoDmembers did various visits at many occasions to, *e.g.*, Bruxelles in Belgium, Cologne in Germany, Gand in Belgium, Bern in Switzerland, Riva del Garda, Italy, and Belo Horizonte in Brazil.

## SEQUEL Project-Team

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

### 8.1.1. Connectome, and large graph mining

**Participant:** Philippe Preux.

- *Title:* Connectome and epilepsy
- *Type:* No funding yet (self-funded project)
- *Coordinator:* Louise Tyvaert, Department of clinical neurophysiology, CHRU Lille, Université de Lille 2, France
- *Others partners:* Mostrare, Inria Lille
- *Duration:* Began in spring 2012
- *Abstract:* The long term goal of this collaboration is to investigate the use of machine learning tools to analyse connectomes, and possibly related EEG signals, to determine, for a given patient, the region of the brain from which originate epilepsy strokes. As a first step, we concentrate on connectome, that is a graph representation of the connectivity in the brain. We study the properties of these graphs from a formal point of view, and try to match these properties with brain activity, and brain disorders.
- *Activity Report:* being a multi-disciplinary project, the first thing was to understanding each others. Connectomes having been acquired at the hospital via MRI and image processing, the resulting graphs have been processed using a spatially regularized spectral clustering approach; we were able to recover well-known brain areas automatically. Indeed, one of the first issues to clarify is the relevance of the graph representation of these MRI data (connectomes), an issue unclear in the medicine community. These first results have been submitted for publication at the IEEE 2013 symposium on Bio-Imaging (ISBI'2013).

## 8.2. National Initiatives

### 8.2.1. DGA/Thales

**Participants:** Emmanuel Duflos, Philippe Vanheeghe, Emmanuel Delande.

- *Title:* Multi-sensor PHD filtering with application to sensor management (<http://www.theses.fr/2012ECLI0001>)
- *Type:* PhD grant
- *Coordinator:* LAGIS - Inria Lille - Nord Europe (SequeL)
- *Others partners:* DGA and Thales Communications
- *Web site:* <http://www.theses.fr/2012ECLI0001>
- *Duration:* *EDIT THIS:* 3 years
- *Abstract:* The defense of this PhD thesis was held in January 2012.
- *Activity Report:*

### 8.2.2. ANR-Lampada

**Participants:** Mohammad Ghavamzadeh, Hachem Kadri, Jérémie Mary, Olivier Nicol, Philippe Preux, Daniil Ryabko, Christophe Salperwyck.

- *Title:* Learning Algorithms, Models and sPArse representations for structured DATA
- *Type:* National Research Agency (ANR-09-EMER-007)
- *Coordinator:* Inria Lille - Nord Europe (Mostrare)
- *Others partners:* Laboratoire d'Informatique Fondamentale de Marseille, Laboratoire Hubert Curien ; Saint Etienne, Laboratoire d'Informatique de Paris 6.
- *Web site:* <http://lampada.gforge.inria.fr/>
- *Duration:* ends mid-2014
- *Abstract:* Lampada is a fundamental research project on machine learning and structured data. It focuses on scaling learning algorithms to handle large sets of complex data. The main challenges are 1) high dimension learning problems, 2) large sets of data and 3) dynamics of data. Complex data we consider are evolving and composed of parts in some relations. Representations of these data embed both structure and content information and are typically large sequences, trees and graphs. The main application domains are web2, social networks and biological data.

The project proposes to study formal representations of such data together with incremental or sequential machine learning methods and similarity learning methods.

The representation research topic includes condensed data representation, sampling, prototype selection and representation of streams of data. Machine learning methods include edit distance learning, reinforcement learning and incremental methods, density estimation of structured data and learning on streams.

- *Activity Report:* Philippe Preux has collaborated with Ludovic Denoyer and Gabriel Dulac-Arnold from LIP'6 to investigate further the idea of datum-wise representation, introduced in 2011, and originally published at ECML/PKDD'2011. This eventually led to a deepened presentation in the *Machine Learning Journal*.

They also studied the reinforcement learning problem in the case of a large but not infinite number of actions (hundreds, or thousands discrete actions). They introduced the use of Error-correcting output codes to deal with this setting, proposed, and studied two RL algorithms that take advantage of an ECOC-based representation of actions. The idea was published at ECML/PKDD'2012 and other conferences (EWRL workshop held as part of the ICML conference, and French ones).

Hachem Kadri and Philippe Preux have continued their work on machine learning for functional data. They introduced an algorithm for multiple operators learning. Along with Mohammad Ghavamzadeh, they only introduced an operator-based approach for structured output.

Daniil Ryabko and colleagues have obtained new results on nonparametric clustering of time-series data. In particular, a fully online clustering algorithm has been developed; we have also shown how to use binary classification methods for clustering time series.

### 8.2.3. ANR EXPLO-RA

**Participants:** Alexandra Carpentier, Mohammad Ghavamzadeh, Jean-François Hren, Alessandro Lazaric, Rémi Munos, Daniil Ryabko.

- *Title:* EXPLORation - EXPLOitation for efficient Resource Allocation with Applications to optimization, control, learning, and games
- *Type:* National Research Agency
- *Coordinator:* Inria Lille - Nord Europe (SequeL, Rémi Munos)

- Others partners: Inria Saclay - Ile de France (TAO), HEC Paris (GREGHEC), Ecole Nationale des Ponts et Chaussées (CERTIS), Université Paris 5 (CRIP5), Université Paris Dauphine (LAMSADE).
- Duration: 2008-2012.
- See also: <https://sites.google.com/site/anexplora/>
- Activity Report: We developed bandit algorithm for planning in Markov Decision Processes based on the optimism in the face of uncertainty principle.

#### 8.2.4. ANR CO-ADAPT

**Participants:** Alexandra Carpentier, Rémi Munos.

- *Title:* Brain computer co-adaptation for better interfaces
- *Type:* National Research Agency
- *Coordinator:* Maureen Clerc
- *Other Partners:* Inria Odyssee project (Maureen Clerc), the INSERM U821 team (Olivier Bertrand), the Laboratory of Neurobiology of Cognition (CNRS) (Boris Burle) and the laboratory of Analysis, topology and probabilities (CNRS and University of Provence) (Bruno Torresani).
- *Web site:* <https://twiki-sop.inria.fr/twiki/bin/view/Projets/Athena/CoAdapt/WebHome>
- *Duration:* 2009-2013
- *Abstract:* The aim of CoAdapt is to propose new directions for BCI design, by modeling explicitly the co-adaptation taking place between the user and the system. The goal of CoAdapt is to study the co-adaptation between a user and a BCI system in the course of training and operation. The quality of the interface will be judged according to several criteria (reliability, learning curve, error correction, bit rate). BCI will be considered under a joint perspective: the user's and the system's. From the user's brain activity, features must be extracted, and translated into commands to drive the BCI system. From the point of view of the system, it is important to devise adaptive learning strategies, because the brain activity is not stable in time. How to adapt the features in the course of BCI operation is a difficult and important topic of research. We will investigate Reinforcement Learning (RL) techniques to address the above questions.
- *Activity Report:* See <https://twiki-sop.inria.fr/twiki/bin/view/Projets/Athena/CoAdapt/WebHome>

#### 8.2.5. ANR AMATIS

**Participant:** Pierre Chainais.

- *Title:* Multifractal Analysis and Applications to Signal and Image Processing
- *Type:* National Research Agency
- *Coordinator:* Univ. Paris-Est-Créteil (S. Jaffard)
- *Duration:* 2011-2015
- *Other Partners:* Univ. Paris-Est Créteil, Univ. Sciences et Technologies de Lille and Inria (Lille, ENST (Telecom ParisTech), Univ. Blaise Pascal (Clermont-Ferrand), and Univ. Bretagne Sud (Vannes), Statistical Signal Processing group at the Physics Department at the Ecole Normale Supérieure de Lyon, one researcher from the Math. Department of Institut National des Sciences Appliquées de Lyon and two researchers from the Laboratoire d'Analyse, Topologie et Probabilités (LAPT) of Aix-Marseille University.
- *Abstract:* Multifractal analysis refers to two concepts of different natures : On the theoretical side, it corresponds to pointwise singularity characterization and fractional dimension determination ; on the applied side, it is associated with scale invariance characterization, involving a family of parameters, the scaling function, used in classification or model selection. Following the seminal ideas of Parisi and Frisch in the mid-80s, these two components are usually related by a Legendre transform, stemming from a heuristic argument relying on large deviation and statistical thermodynamics prin-

principles : The multifractal formalism. This led to new theoretical approaches for the study of singularities of functions and measures, as well as efficient tools for classification and models selection, that allowed to settle longstanding issues (e.g., concerning the modeling of fully developed turbulence). Though this formalism had been shown to hold for large classes of functions of widely different origins, the generality of its level of validity remains an open issue. Despite its popularity in applications, the interactions between theoretical developments and applications are unsatisfactory. Its use in image processing for instance is still in its infancy. This is partly due to discrepancy between the theoretical contributions mostly grounded in functional analysis and geometric measure theory, and applications naturally implying a stochastic or statistical framework. The AMATIS project aims at addressing these issues, by proposing a consistent and documented framework combining different theoretical approaches and bridging the gap towards applications. To that end, it will both address a number of challenging theoretical issues and devote significant efforts to elaborating a WEB platform with softwares and documentation. It will combine the efforts of mathematicians with those of physicists and experts in signal and image processing. Dissemination among and interactions between scientific fields are also intended via the organization of summer schools and workshop.

- *Activity Report*: a collaboration with P. Bas (CR CNRS, LAGIS) has started on the steganalysis of textured images. While steganography aims at hiding a message within some support, e.g. a numerical image, steganalysis aims at detecting the presence or not of any hidden message in the support. Steganalysis involves two main tasks: first identify relevant features which may be sensitive to the presence of a hidden message, then use supervised classification to build a detector. While the steganalysis of usual images has been well studied, the case of textured images, for which multifractal models may be relevant, is much more difficult. Indeed, textured images have a rich and disordered content which favors hiding information in an unperceptible manner. A student internship of 6 months at Master level has finished in November. The purpose was to explore the potential of new multiscale wavelet based discriminant features for steganalysis.

### 8.2.6. National Partners

- Inria Nancy - Grand Est, Team MAIA, France.
  - Bruno Scherrer *Collaborator*  
We have had collaboration on the topics of *approximate dynamic programming and statistical learning* and *high-dimensional reinforcement learning* this year. On the first topic, we have published a conference paper [47] and a technical report [62], and on the second one we have published a conference paper [36] together.
- Supélec, IMS Research Group, Metz, France.
  - Matthieu Geist *Collaborator*  
We have had collaboration on the topics of *approximate dynamic programming and statistical learning* and *high-dimensional reinforcement learning* this year. On the first topic, we have published a conference paper [47] and a technical report [62], and on the second one we have published a conference paper [36] together.
- LIP'6, UPMC, Paris, France.
  - Ludovic Denoyer *Collaborator*  
We have a collaboration on the topic of *reinforcement learning, sparse representation*. We have worked on the datum-wise representation of data, as well as the handling of large but non infinite sets of actions. See section 8.2.2 for further details.

## 8.3. European Initiatives

### 8.3.1. FP7 Projects

#### PASCAL-2

**Participants:** the whole SEQUEL team is involved.

- *Title:* Pattern Analysis, Statistical Modeling, and Computational Learning
- *Type:* Cooperation (ICT), Network of Excellence (NoE)
- *Coordinator:* Univ. Southampton
- *Others partners:* Many european organizations, universities, and research centers.
- *Web site:* <http://www.pascal-network.org/>
- *Duration:* March 2008 - February 2013

#### **PASCAL-2 Pump Priming Programme**

**Participants:** Mohammad Ghavamzadeh, Rémi Munos.

- *Title:* Sparse Reinforcement Learning in High Dimensions
- *Type:* PASCAL-2 Pump Priming Programme
- *Partners:* Inria Lille - Nord Europe, Shie Mannor (Technion, Israel)
- *Web site:* <http://sites.google.com/site/sparsersl/home>
- *Duration:* November 2009 - September 2012
- *Abstract:* With the explosive growth and ever increasing complexity of data, developing theory and algorithms for learning with high-dimensional data has become an important challenge in statistical machine learning. Although significant advances have been made in recent years, most of the research efforts have been focused on supervised learning problems. We propose to design, analyze, and implement reinforcement learning algorithms for high-dimensional domains. We will investigate the possibility of using the recent results in  $l_1$ -regularization and compressive sensing in reinforcement learning.
- *Activity report:* The project ended early this year. The list of publications obtained within the project is listed at <https://sites.google.com/site/sparsersl/publications>.

#### **ComPLACS**

**Participants:** Mohammad Ghavamzadeh, Nathan Korda, Prashanth Lakshmanrao Anantha Padmanabha, Alessandro Lazaric, Rémi Munos, Philippe Preux, Daniil Ryabko, Michal Valko.

- *Title:* Composing Learning for Artificial Cognitive Systems
- *Type:* Cooperation (ICT), Specific Targeted Research Project (STREP)
- *Coordinator:* University College of London
- *Other partners:* University College London, United Kingdom (John Shawe-Taylor, Stephen Hailes, David Silver, Yee Whye Teh), University of Bristol, United Kingdom (Nello Cristianini), Royal Holloway, United Kingdom (Chris Watkins), Radboud Universiteit Nijmegen, The Netherlands (Bert Kappen), Technische Universitat Berlin, Germany (Manfred Opper), Montanuniversitat Leoben, Austria (Peter Auer), Max-Planck Institute of Biological Cybernetics, Germany (Jan Peters).
- *Web site:* <http://www.complacs.org/>
- *Duration:* March 2011 - February 2015
- *Abstract:* One of the aspirations of machine learning is to develop intelligent systems that can address a wide variety of control problems of many different types. However, although the community has developed successful technologies for many individual problems, these technologies have not previously been integrated into a unified framework. As a result, the technology used to specify, solve and analyse one control problem typically cannot be reused on a different problem. The community has fragmented into a diverse set of specialists with particular solutions to particular problems. The purpose of this project is to develop a unified toolkit for intelligent control in many different problem areas. This toolkit will incorporate many of the most successful approaches to a variety of important control problems within a single framework, including bandit problems, Markov Decision Processes (MDPs), Partially Observable MDPs (POMDPs), continuous stochastic control,



and multi-agent systems. In addition, the toolkit will provide methods for the automatic construction of representations and capabilities, which can then be applied to any of these problem types. Finally, the toolkit will provide a generic interface to specifying problems and analysing performance, by mapping intuitive, human-understandable goals into machine-understandable objectives, and by mapping algorithm performance and regret back into human-understandable terms.

- *Activity report:* We worked on WorkPackage 2 (multi-armed bandits and extensions) and we designed hierarchical bandit-based planning algorithms for MDPs and POMDPs.

## 8.4. International Initiatives

### 8.4.1. Inria Associate Teams

#### SEURL

- *Title:* Decision-making under Uncertainty with Applications to Reinforcement Learning, Control, and Games
- *Inria principal investigator:* Rémi Munos
- *International Partner:*
  - *Institution:* University of Alberta (Canada)
  - *Laboratory:* Department of Computer Science
  - *Principal investigator:* Csaba Szepesvári
- *Duration:* January 2010 - January 2013
- *Website:* <http://sites.google.com/site/associateteamualberta/home>
- *Abstract:* This associate team aims at bridging researchers from the SequeL team-project at Inria Lille with the Department of Computing Science of the University of Alberta in Canada. Our common interest lies in machine learning, especially reinforcement learning, bandit algorithms and statistical learning with applications to control and computer games. The department of Computing Science at the University of Alberta is internationally renown as a leading research institute on these topics. The research work spans from theory to applications. Grounded on an already existing scientific collaboration, this associate team will make it easier to collaborate further between the two institutes, and thus strengthen this relationship. We foresee that the associate team will boost our collaboration, create new opportunities for financial support, and open-up a long-term fruitful collaboration between the two institutes. The collaboration will be through organizing workshops and exchanging researchers, postdoctoral fellows, and Ph.D. students between the two institutes.
- *Activity report:* This year we had two Ph.D. students from the university of Alberta, Yasin Abbasi and Bernardo Avila Pires, who visited SequeL for six and four weeks, respectively. We send our Ph.D. student Amir Sani to a workshop organized by the university of Alberta and McGill university in Barbados in April. Mohammad Ghavamzadeh had a one week visit to the university of Alberta to work with Csaba Szepesvári and Bernardo Avila Pires.
- *Joint Publications:* We have one conference paper submitted [53] and one in preparation [61] this year.

### 8.4.2. Inria International Partners

- University of Alberta, Edmonton, Alberta, Canada.
  - Prof. Csaba Szepesvári *Collaborator*
  - Bernardo Avila Pires *Collaborator*
 With Csaba Szepesvári we managed the associate team with the university of Alberta. We have had several visits to SequeL and UAlberta this year. We also have a conference paper [61] on *risk bounds in cost-sensitive multiclass classification* in preparation with Csaba Szepesvári and Bernardo Avila Pires.

- McGill University, Montreal, Quebec, Canada.
  - Prof. Joelle Pineau *Collaborator*
  - Prof. Doina Precup *Collaborator*
  - Amir massoud Farahmand *Collaborator*
 Mohammad Ghavamzadeh and Rémi Munos wrote a proposal with Joelle Pineau, Doina Precup, and Amir Farahmand to start an associate team with the McGill university. Mohammad Ghavamzadeh also have a conference paper submitted [53] on *classification-based approximate policy iteration* with Amir Farahmand and Doina Precup.
- Technion - Israel Institute of Technology, Haifa, Israel.
  - Prof. Shie Mannor *Collaborator*
 Mohammad Ghavamzadeh continued his collaboration with Shie Mannor. This year, we co-authored a book chapter on *Bayesian reinforcement learning* [57].
- University of Waterloo, Waterloo, Ontario, Canada.
  - Prof. Pascal Poupart *Collaborator*
 Mohammad Ghavamzadeh continued his collaboration with Pascal Poupart. This year, we co-authored a book chapter on *Bayesian reinforcement learning* [57].
- University of Waterloo, Waterloo, Ontario, Canada.
  - Prof. Carl Haas *Collaborator*
- University of Waterloo, Waterloo, Ontario, Canada.
  - Prof. Giovanni Cascante *Collaborator*
- Politecnico di Milano, Italy.
  - Prof. Marcello Restelli *Collaborator*
  - Prof. Nicola Gatti *Collaborator*
 We continued our collaboration on transfer in reinforcement learning and we developed a novel collaboration focused on the interplay between bandit theory and mechanism design, notably in the sponsored search auction application domain [35].
- Technicolor Research, Palo Alto.
  - Branislav Kveton *Collaborator*
 We have an ongoing collaboration related to the sequential graph-based learning. This involves both theory and the application to industry, such as sequential face recognition. Currently we investigate the problem of face detection from a single labeled face and the streams of unlabeled data.

## 8.5. International Research Visitors

- Ronald Ortner, from University of Leoben, Austria.  
Period: spent his sabbatical Jan-Oct 2012 with us. Some papers as a result of this collaboration are [43], [44]; some more are under submission.
- Gusztav Morvai, senior research at Budapest University of Technology and Economics.  
Period: Oct 18-24, 2012
- Tor Lattimore, Ph.D. student at Australian National University.  
Period: Nov. 2-9, 2012
- Bernardo Avila Pires  
Period: May 2012 (one month)  
He worked with Mohammad Ghavamzadeh on *risk bounds in cost-sensitive multiclass classification*. The outcome of this collaboration has been a conference paper in preparation [61] so far.

- Joelle Pineau  
Period: September 2012 (one week)  
Prof. Pineau visited SequeL for one week as a part of her sabbatical. During her stay, in addition to have discussions with SequeL team members and giving two talks on her research, she wrote a proposal with Mohammad Ghavamzadeh and Rémi Munos to start an associate team between SequeL and McGill university.
- Pr. Giovanni Cascante, University of Waterloo, Waterloo, Ontario, Canada.  
Period: June 2012  
He worked with Philippe Vanheeghe and Emmanuel Duflos on parameters estimation in acoustic probing in civil engineering. The outcome of this collaboration has been a project master (from November 2012) and a proposition of research project under evaluation the University of Waterloo so far.

### 8.5.1. Internships

- Louis Dacquet, student at Ecole Centrale Lille.  
Period: April-June 2012.  
He worked with Pierre Chainais on *blind image deconvolution*.
- Alexandre Kazmierowski, student at Ecole Telecom ParisTech.  
Period: June-July 2012.  
He worked with Pierre Chainais and Antoine Gloria (SIMPAF project) on textured models for heterogeneous media and homogeneization theory in PDEs.
- Phuong Nguyen, Ph.D. student at Australian National University.  
Period: 15 February - 30 April 2012  
He worked with Daniil Ryabko on state representation for reinforcement learning. As a result, one paper is submitted and one is being prepared.
- Florian Gas, Student at the Ecole Centrale de Lille, France.  
Period: May 2012 - July 2012.  
He worked with Emmanuel Duflos on foundations of Sequential Monte Carlo Methods in high dimension

## SHACRA Project-Team

# 8. Partnerships and Cooperations

## 8.1. National Initiatives

### 8.1.1. *Sofa, ADT*

SOFA Large Scale Development Initiative (ADT) : the SOFA project (Simulation Open Framework Architecture) is an international, multi-institution, collaborative initiative, aimed at developing a flexible and open source framework for interactive simulations. This will eventually establish new grounds for a widely usable standard system for long-term research and product prototyping, ultimately shared by academic and industrial sites. The SOFA project involves 3 Inria teams, SHACRA, EVASION and ASCLEPIOS. The development program of the ADT started in 2007. After 3 years of development, more than 600,000 lines of code have been developed, 80,000 downloads of SOFA have been counted on the Inria gForge, and we are about to finalize a new version of the public release.

### 8.1.2. *Sofa Intermeds, AEN*

SOFA Large Scale Initiative on Medical Simulation (AEN): The variety and complexity of Medicine, as well as its ethical importance in today's society, have been a strong motivation in many scientific and technical disciplines. The medical field has already been a domain of application for computer science and several tools, such as image processing, are now an integral part of modern medicine. Yet, there is no question that the integration of new technologies in Medicine will continue to rise in the future. In this context, the simulation of medical procedures, whether it is targeted at education, planning of interventions, or even guidance during complex procedures, will be a major element of the Medicine of the twenty-first century. The main objective of this large scale initiative is to leverage expertise from a few research teams at Inria to speed up the development of new ideas, models, algorithms in this very multi-disciplinary field. This initiative started in 2008, and involves several teams at Inria: SHACRA, EVASION, ASCLEPIOS, MOAIS, MAGRIT, and BUNRAKU. This program has been evaluated by a group of international experts in October 2010.

### 8.1.3. *ANR Acoustic*

The main objective of this project is to develop an innovative strategy based on models for helping decision-making process during surgical planning in Deep Brain Stimulation. Models will rely on different levels involved in the decision-making process; namely multimodal images, information, and knowledge. Two types of models will be made available to the surgeon: patient specific models and generic models. The project will develop methods for 1) building these models and 2) automatically computing optimal electrodes trajectories from these models taking into account possible simulated deformations occurring during surgery. The project belongs to the multidisciplinary domain of computer-assisted surgery (CAS). Computer assisted surgery aims at helping the surgeon with methods, tools, data, and information all along the surgical workflow. More specifically, the project addresses surgical planning and surgical simulation in Image Guided Surgery. It is related to the exponentially growing surgical treatment of Deep Brain Stimulation (DBS), originally developed in France by Pr. Benabid (Grenoble Hospital). The key challenges for this research project are 1) to identify, extract, gather, and make available the information and knowledge required by the surgeon for targeting deep brain structures for stimulation and 2) to realistically simulate the possible trajectories.

### 8.1.4. *IHU, Strasbourg*

Our team has been selected to be part of the IHU of Strasbourg. This new institute, for which funding (67M€) has just been announced, is a very strong innovative project of research dedicated to future surgery of the abdomen. It will be dedicated to minimally invasive therapies, guided by image and simulation. Based on interdisciplinary expertise of academic partners and strong industry partnerships, the IHU aims at involving several specialized groups for doing research and developments towards hybrid surgery (gesture of the surgeon and simulation-based guidance). Our group and SOFA have an important place in the project. For this reason, Stephane Cotin has moved to Strasbourg for two years (Sept 2011 to July 2013).

### **8.1.5. ANR IDeaS**

IDEaS is a project targeted at per-operative guidance for interventional radiology procedures. Our main goal is to provide effective solutions for the two main drawbacks of interventional radiology procedures, namely: reduce radiation exposure and provide a fully 3D and interactive visual feedback during the procedure. To do so, our project relies on an original combination of computer vision algorithms and interactive physics-based medical simulation. Computer vision algorithms extract relevant information (like the actual projected shape of the guide-wire at any given time) from X-ray images, allowing adjusting the simulation to real data. Conversely, computer-based simulation is used as a sophisticated and trustful predictor for an improved initialization of computer vision tracking algorithms. Many outcomes may be expected both in scientific and clinical aspects. On the scientific side, we believe a better understanding of how real data and simulation should be merged and confronted must lead, as a natural by-product, to image-based figures of merit to actually validate computer-based simulation outputs against real and dynamic data. A more accurate identification of the factors limiting the realism of simulation should follow with a rebound impact on the quality of the simulation itself. An actual integration of a mechanical model into the loop will improve the tracking. We firmly believe mechanical constraints can supplement the image data such that dynamic single view reconstruction of the interventional devices will be possible. On the clinical side, using the prediction capabilities of the simulation may decrease the need for X-ray images at high rates, thus leading to lower exposure to radiations for the patients and surgical staff. Finally, the output of the simulation is the 3D shape of the tool (e.g. guide-wire or catheter), but not only. Additional information may be visualized, for instance pressure of the catheter on the arterial wall, to prevent vessel wall perforations, or reduce stress on the arterial wall to prevent spasm. More generally, richer information on the live procedure may help surgeons to reduce malpractice or medical errors.

## **8.2. International Research Visitors**

### **8.2.1. Internships**

Yiyi WEI (from Jan 2012 until Mar 2012)

Subject: Simulation of Coil Embolization using the Discrete Exterior Calculus Approach

Institution: Beihang University of Aeronautics and Astronautics (China)

## SIMPAF Project-Team

# 8. Partnerships and Cooperations

## 8.1. National Initiatives

### 8.1.1. Collaborations within Inria

MICMAC (M. Rousset)  
REO (A. Gloria)  
COFFEE (E. Creusé and C. Calgaro)  
POEMS (C. Besse and I. Lacroix-Violet)  
CORIDA (C. Besse)  
IPSO (C. Besse)

### 8.1.2. ANR

#### 8.1.2.1. ANR MICROWAVE (2009-2012)

**Participants:** Christophe Besse, Ingrid Lacroix-Violet.

Ch. Besse and I. Lacroix-Violet are members of the new 4-years ANR "blanche" project MICROWAVE. Ch. Besse is the North node coordinator. The scientific subjects deal with artificial boundary conditions for dispersive equations, electromagnetism and high frequency regimes in acoustic simulations. This ANR project concerns the development of new numerical methods for wave propagation problems using tools from microlocal analysis. It focuses on microlocal analysis and numerical methods for acoustic and electromagnetic wave scattering and microlocal analysis and numerical methods for Schrödinger-type equations.

#### 8.1.2.2. ANR IODISSEE (2009-2012)

**Participants:** Christophe Besse, Pauline Lafitte.

C. Besse has obtained a 4-years ANR grant, from the Cosinus proposal, for the project IODISSEE. P. Lafitte and C. Yang, also members of the EPI Simpaf, are involved in this project. The project IODISSEE also involves a team of mathematicians from Toulouse, a physicist team from Versailles and the Thales group. It deals with the elaboration of a physical model for helping the industrial partner for the new generation of Galileo satellites. For the last decade, satellite positioning devices became one of the most interesting means of navigation for the displacement of the goods and the people. The only current solution is based on the constellation of satellites Navstar GPS American system. Originally developed for military applications, its use was released under the Clinton administration. However, in order to guarantee its autonomy, Europe decided to launch a competitor program known as Galileo. Galileo system differs from the GPS thanks to its capability to provide real time integrity information to the user. In order to guarantee the stability of this system, it is fundamental to take into account the various problems which can affect the mission and to identify all the potential sources of system unavailability. One of the main source of data unavailability that has been identified is the phenomena of ionospheric scintillations. Indeed scintillation causes radio frequency signal amplitude fades and phase variations as satellite signals pass through the ionosphere. Such effects may induce loss of lock or cycle slips on ranging signals broadcast by Galileo satellites making them totally useless for accurate integrity information determination. Scintillations are clearly identified like a source of disturbances. They appear as the turbulent aspect of a larger disturbance of the ionospheric plasma density which have the shape of a plasma bubble. The difficulty of their modelling is due to the lacks of in situ measurements with regard to them. However, some measurements recently acquired during the mission of satellite DEMETER make possible on the one hand the validation of the models existing but also, using techniques of data-models coupling, to reinforce them. The object of this proposal is therefore to provide a physical model making it possible to anticipate the attenuation of the signals during their propagation within the disturbed Earth ionosphere.

### 8.1.2.3. ANR MEGAS (2009-2012)

**Participant:** Mathias Rousset.

M. Rousset is involved in the ANR MEGAS. The main scientific subject is numerical methods in Molecular Dynamics simulation.

### 8.1.2.4. ANR INTOCS (2009-2012)

**Participant:** Pauline Lafitte.

The main scientific subject of the project is the interaction of compressible waves, and more precisely the propagation of high frequency oscillations in hyperbolic boundary value problems. One of the physical motivations is the "Mach stems" formation in reacting gas flows. The head of the project is JF Coulombel (Univ. Nantes), former member of SIMPAF.

### 8.1.2.5. ANR AMAM (2011-2014)

**Participant:** Antoine Gloria.

A. Gloria is involved in the 4-year ANR project "young researcher" AMAM, led by V. Millot (Paris 7). The aim of the project is to develop mathematical tools for the analysis of multiscale problems in material sciences (PDEs and variational methods). The fields of interest are primarily micromagnetics, dislocations, fatigue in nonlinear elasticity, and homogenization.

### 8.1.2.6. ANR STAB (2013-2017)

**Participant:** Pauline Lafitte.

STAB (starting in 2013) : Most of the natural time-evolving systems that one encounters in Physics, Biology, Economics..., can be described by means of evolution equations, or systems of such equations. These equations may include randomness or not. During the last decade, a lot of progress has been made in the understanding of the stabilization of these dynamics, i.e. their convergence to equilibrium. In particular the picture of the qualitative description of the rate of convergence is now almost complete for symmetric models (reversible dynamics). However, the non-reversible setting is still insufficiently understood. One of the most fascinating features of this research area is the strong intricacy between the analysis of partial differential equations and stochastic methods, each approach enlightening the other one. The main goal of this project is to go further, developing tractable and efficient tools, in particular for numerical schemes and algorithms, based on the computation of explicit theoretical bounds. Hence, even if part of the project is devoted to the theoretical study of non-reversible or highly degenerate situations (we typically have to face kinetic or reaction-diffusion models for example), the heart of the project will include discretization schemes, approximating particle systems and concrete simulation situations (including boundary conditions). This concerns the stability of the discretization or numerical methods. The acronym STAB covers both aspects: stabilization and stability. Indeed, sensitivity to small perturbations (or to boundary conditions) is the first definition of large time stability for numerical schemes. The head of the project is I. Gentil (Univ. Lyon1).

## 8.1.3. Competitivity Clusters

### 8.1.3.1. LABEX Centre Européen pour les Mathématiques, la Physique et leurs Interactions – CEMPI (2012-2019)

The "Laboratoire d'Excellence" CEMPI was created by the French government within the framework of its "Projets d'Investissement d'Avenir" program, in February 2012. It is a joint venture of the Laboratoire Paul Painlevé (mathematics) and the Laboratoire Physique des Lasers, Atomes et Molécules (PhLAM). Several members of CEMPI participate actively in the CEMPI research and training project, notably through the focus area "The interaction of mathematics and physics". The corresponding research is described in Sections 3.2.4 and 3.5 .

## 8.2. European Initiatives

### 8.2.1. Collaborations with Major European Organizations

Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany (F. Otto)

Quantitative homogenization theory (see Section 3.2.1 )