



RESEARCH CENTER  
Lille - Nord Europe

FIELD

Activity Report 2013

# Section Partnerships and Cooperations

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## **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**

- Oscar Nierstrasz, PhD, Professor - Professor of Computer Science at the Institute of Computer Science (IAM) of the University of Bern
- Anya Helene Bagge, PhD - University of Bergen, Norway
- Sebastian Erdweg, PhD - TU Darmstadt

##### **6.3.1.1. Internships**

- Kevin van der Vlist
- Davy Meers
- Wouter Kwakernaak
- Jimi van der Woning
- Ioana Rucareanu
- Ioannis Tzanellis
- George Marminidis
- Vlad Lep
- Dimitrios Kyritsis
- Chris Mulder

## DREAMPAL Team

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

### 8.1.1. IRCICA project " Smart Cities"

*Smart Cities* is an interdisciplinary project, internal of IRCICA (<http://www.ircica.univ-lille1.fr/>), in collaboration with the laboratory of Civil Engineering of Lille I. It builds on the expertise of several teams hosted by IRCICA (RF networks, sensors, high-performance and real-time embedded systems computing, pattern recognition). The scientific problem, we tackle within this project, is to develop an intelligent platform for managing accidents and incidents in the drinking water and wastewater. In this platform, a permanent dialogue M2M (machine to machine) between servers, embedded systems (laptops, smartphones, tablets, ...), smart cameras, and sensors, will detect and solve problems in real time.

Scientific problems relate to the study of the possibility of linking objects (cameras, sensors, servers ...) all together, with a standardized mixed network (radio frequency wifi and internet). DreamPal is responsible for implementing the part of the hardware platform for high performance dedicated to intelligent video applications using the HoMade softcore. This work involves the processing of data, analysis of video images, the use of these data, and the integration of embedded reconfigurable components (on Xilinx Zynq 7000 board) as well as the existing RF network cards. It uses the video data acquisition to apply algorithms to detect such an anomaly on the water in a part of the building, or abnormal number of people in a given area, or any information about a specific person such as the recognition of face, the nature of motion. The work done during this year usefully supplements our platform by developing video modules dedicated to intelligent surveillance.

## 8.2. International Initiatives

We have a strong ongoing collaboration with Univ. Iasi, Romania, which includes (but is not limited to) the co-supervision of the PhD of Andrei Arusoae. Collaboration topics include language-independent techniques for analysis of programs, and their specialization to the languages designed in the Dreampal project (HiHope, HoMade assembler and machine code).

## 8.3. International Research Visitors

### 8.3.1. Visits of International Scientists

Prof. Dorel Lucanu, Assist. Prof./ Stefan Ciobaca, and PhD student Andrei Arusoae from Univ. Iasi (Romania) visited us in July 2013. We initiated work on language-independent program-verification techniques and on the formal definitions of the HiHope and HoMade assembler languages, as well as on the formally proved correctness of compilation between these languages.

### 8.3.2. Internships

Kanwarjeet Dhaliwal made his internship in the Dreampal team from May to July 2013. He worked on the formal semantics of the parallel version of Hihope, and also made a preliminary work to compile Hihope to the Kalray's MPPA platform. This work was partially funded by Kalray (<http://www.kalray.eu>).

### 8.3.3. Visits to International Teams

In June 2013, Rabie Ben Atitallah and Wissem Chouchene visited Michael Huebner, Professor and Chair for Embedded Systems in Information Technique (ESIT) at the Ruhr-University of Bochum. The objective is to establish a new collaboration in the field of 3D FPGA next generation.

In October 2013, Andrei Arusoae visited the team of Prof. Grigore Roşu at the University of Illinois at Urbana Champaign, where he worked on implementing the symbolic domains used in our language-independent symbolic execution and verification tool. He benefitted from the guest team's expertise on symbolic domains.

## **DOLPHIN Project-Team**

# **8. Partnerships and Cooperations**

## **8.1. Regional Initiatives**

- PPF (Bioinformatics): This national program within the University of Lille 1 deals with solving bioinformatics and computational biology problems using combinatorial optimization techniques, 2010-2013.
- PPF HPC (High performance computing), 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 Blackbox 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. Collaborations in European Programs, except FP7**

Program: COST

Project acronym: IC0804

Project title: Energy efficiency in large scale distributed systems

Duration: Jan 2009 - May 2013

Coordinator: J. M. Pierson

Other partners: More than 20 European countries.

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

### **8.3.2. 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):

Polytechnic School of Montréal (Canada) - Département de mathématique et génie industriel

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

Duration: 2012 - 2014

See also: <http://dolphin.lille.inria.fr/Dolphin/EA-DOLPHIN>

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, Canada
- Ecole Polytechnique of Montreal, Canada

#### 8.4.2.1. Declared Inria International Partners

- University of Luxembourg, Luxembourg

#### 8.4.2.2. Informal International Partners

- University of Shinshu, Nagano, Japan: Evolutionary multi-objective optimization, landscape analysis, and search performance (JSPS project 2013-2016)
- Cooperation with Hernan Aguirre et Tanaka : Internship in Japan of A. Blot co-supervised by H. Aguirre, C. Dhaenens, L. Jourdan and Tanaka

### 8.4.3. Participation In other International Programs

- Inria STIC-Tunisie 2011-2013.
- CNRS PICS Luxembourg 2012-2014.

- Japanese Government Grant Program 2013.

## **8.5. International Research Visitors**

### ***8.5.1. Visits of International Scientists***

- Dr. Hernan Aguirre, Shinshu University, Japan
- Prof. Kiyoshi Tanaka, Shinshu University, Japan
- Prof. Michel Gendreau, University of Montreal
- Prof. Pascal Bouvry, University of Luxembourg

#### ***8.5.1.1. Internships***

- Martin Drozdik [PhD student, Shinshu University, Japan, from Nov 2013]

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

- E-G. Talbi, June 2013, Univ. Colchester, Sussex, UK
- E-G. Talbi, April 2013, Univ. Murcia, Spain



## MODAL Project-Team

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

- Christophe Biernacki: Industrial studies, Arcelor-Mittal (C. Théry)
- Sophie Dabo-Niang:
  - Festival NEXT avec la ROSE DES VENTS : programme Cartes et Cartel du spectacle vivant – stratégies et fréquentation du festival NEXT en Nord Pas de Calais et Belgique (Tournai).
  - SIRIC (Site de Recherche Intégrée en Cancérologie) ONCOLILLE
- Guillemette Marot:
  - Institut Pasteur Lille, Équipe Etudes Transcriptomiques et Génomiques Appliquées, D. Hot
  - Institut Pasteur Lille, Équipe Peste et Yersinia pestis, F. Sebbane
  - Institut de Biologie de Lille, Unité d’approches fonctionnelle et structurale des cancers, O. Pluquet
  - Université Lille 2, Plate-forme de génomique fonctionnelle et Structurale, M. Figeac
  - CHRU Lille, Centre de Biologie Pathologie, Laboratoire d’Hématologie, C. Preudhomme

## 8.2. National events

- Alain Celisse belongs to the Statistics for Systems Biology group (SSB) in Paris.
- Julien JACQUES organized the first French Summer School in Astrostatistics (Annecy, October 2013).
- Christophe Biernacki co-organized with Gilles Celeux, Gérard Govaert and Florent Langrogné the 4th one-day meeting on Mixmod on September 2013 (~ 50 participants).
- Guillemette Marot belongs to the StatOmique working group <http://vim-iip.jouy.inra.fr:8080/statomique/>

## 8.3. International Research Visitors

### 8.3.1. Visits of International Scientists

Mahlet Tadesse (University of Georgetown), Mohamed Ben Alaya (INRS, Québec), Aliou Diop (University of Gaston Berger, Senegal), Papa Ngom (University UCAD, Senegal).

#### 8.3.1.1. Internships

Every year the Modal team welcomes numerous internships from various areas: Master 2 (Applied mathematics in Lille 1, Besançon,...), École centrale Lille, École PolytechLille, IUT A,...Some of them are awarded by a grant and then become PhD students (Jérémy Kellner, Quentin Grimonprez, Julie Hamon, Mathieu Marbac-Lourdelle,...).

### 8.3.2. Visits to International Teams

Julien Jacques was invited to the Working-Group on Model-Based Clustering of Adrian Raftery (Univ. Washington).

## NON-A Project-Team

# 7. Partnerships and Cooperations

## 7.1. Regional Initiatives

- Project ARCIR «Estimation distribuée de systèmes dynamiques en réseaux», supervisor Prof. Mihaly Petreczky, URIA – Mines de Douai, 2013–2015
- CPER CIA, "Internet of Things", 2011–2015
- CPER CISIT, "Campus international sur la securite et intermodalite de transport", project "CONTRAERO" with LML and IEMN, 2011–2015
- ADT Inria SLIM "Development of ROS software library for multi-robots cooperation", 2013–2014
- Project Agrégation, Conseil Général du Val d’Oise, (<http://www.scilab.org/fr/community/scilabtec/2013/Projet-Agregation-la-simulation-numerique-dans-les-essais>)

## 7.2. National Initiatives

- CNRS GDRI DelSys (<http://www.cnrs.fr/ins2i/spip.php?article217>)
- CNRS-CONACYT project with Mexico, "Estimation of state for hybrid systems using sliding mode techniques", 2013
- ANR project ChaSlIM (Chattering-free Sliding Modes), coordinator Prof. B. Brogliato: 2012-2015
- We are also involved in several technical groups of the GDR MACS (CNRS, "Modélisation, Analyse de Conduite des Systèmes dynamiques", see <http://www.univ-valenciennes.fr/GDR-MACS>), in particular: Technical Groups "Identification", "Time Delay Systems", "Hybrid Systems" and "Control in Electrical Engineering".
- Model-free control: collaborations with Professor Brigitte D’Andréa-Novel at Mines ParisTech and Professor Emmanuel Delaleau at ENIB (Brest).
- Atomic Force Microscope (AFM): application of new algebraic methods in tapping mode for AFM, collaboration with the National Laboratory of Metrology (LNE) located at Trappes.

## 7.3. European Initiatives

### 7.3.1. FP7 Projects

- *HYCON2* (<http://www.hycon2.eu/>) The FP7 NoE HYCON2, started in September 2010, is a four-year project coordinated by the CNRS (Françoise Lamnabhi-Lagarrigue). It aims at stimulating and establishing a long-term integration in the strategic field of control of complex, large-scale, and networked dynamical systems. It focuses in particular on the domains of ground and aerospace transportation, electrical power networks, process industries, and biological and medical systems.
- *SYSIASS* (<http://www.sysiass.eu/>) Here is the major issue on which the project SYSIASS seeks to answer by developing new technologies and putting them in the service of patients and health professionals from our regions. Indeed preserve the autonomy of the elderly and disabled people is a major issue in today’s society. In Europe, with the progressive ageing of the population policy to support the elderly is increasingly based on the assumption that care must be provided efficiently to the patient where he is based. In addition, special attention is devoted to people with disabilities for their better integration into society. Advances in technology proposed by SYSIASS (SYStème Intelligent et Autonome d’aide aux Soins de Santé / Autonomous and Intelligent Healthcare System) will be realized in practice through an intelligent wheelchair that can provide better mobility to the patient and to allow health care professionals to easily transport patients to desired locations within a clinic or home environment. Moreover such a system must be able to communicate with the outside world, to adapt to specific patient needs and any special disability that he may have, and to facilitate access to medical data for health professionals.

- *ICityForAll: EU Ambient Assisted Living Program* (<http://www.icityforall.eu/>) The project is led by CEA and it includes University of Paris Descartes-UPD, CENTICH, Active Audio (SME, France), Tech. Univ of Munich - TUM (Germany), EPFL (Suisse), ENEA (Italy), Centro Ricerche FIAT-CRF (Italy). The goal of I'City for All (Age sensitive ICT systems for Intelligible City for All) is to enhance speech and audio alarms intelligibility in order to improve the sense of well-being of seniors through better social interactions, better security and then improved mobility. Mamadou Mboup is involved as a subcontractor of UPD.

## 7.4. International Initiatives

### 7.4.1. Inria International Partners

#### 7.4.1.1. Informal International Partners

- Professor Emilia Fridman, Tel Aviv University, Israel
- Sliding Mode Control Laboratory, UNAM, Mexico
- Department Control Automatico, CINVESTAV-IPN, Mexico
- Department of Control Systems and Informatics, Saint Petersburg State University of Information Technologies Mechanics and Optics (ITMO), Russia

### 7.4.2. Inria International Labs

*Inria North European Labs 2013, "Dynamical precision improvement for industrial robots", project with Norwegian University of Science and Technology (Trondheim, Norway) and UMEA university (Sweden), 2013–2016*

This collaborative project aims on development of algorithms used in software of industrial robots for estimation, regulation and trajectory planning in order to improve accuracy and repeatability of robots in the presence of varying parameters, perturbations and noises. A special attention is paid to the case when it is necessary to realize by robot effector a complex 3D movement with a good precision (3D surface profiling), where conventional calibration procedures fail to guarantee the required technical parameters.

## 7.5. International Research Visitors

### 7.5.1. Visits of International Scientists

#### 7.5.1.1. Internships

Lucas Langwagen

Subject: Numerical differentiation of noisy piecewise regular signal

Date: from Apr 2013 until Aug 2013

Institution: University of the Republic (Uruguay)

Leonid Fridman

Subject: State Observation and Parameter Identification in Hybrid Systems via High-Order Sliding-Modes

Date: June 2013 until July 2013

Institution: UNAM (Mexico)

Héctor Rios

Subject: State Observation and Parameter Identification in Hybrid Systems via High-Order Sliding-Modes

Date: June 2013 until July 2013

Institution: UNAM (Mexico)

Emmanuel Cruz

Subject: State Observation and Parameter Identification in Hybrid Systems via High-Order Sliding-Modes

Date: November 2013 until December 2013

Institution: UNAM (Mexico)

Tonametl Sanchez

Subject: State Observation and Parameter Identification in Hybrid Systems via High-Order Sliding-Modes

Date: November 2013 until December 2013

Institution: UNAM (Mexico)

Emilia Fridman

Subject: Time-delay and Hybrid Systems

Date: June 2013 until July 2013

Institution: Tel Aviv University (Israel)

### **7.5.2. Visits to International Teams**

- G. Zheng, Zhejiang University, China, May 2013

## SequeL Project-Team

# 8. Partnerships and Cooperations

## 8.1. National Initiatives

### 8.1.1. ANR-Lampada

**Participants:** Mohammad Ghavamzadeh, Jérémie Mary, Olivier Nicol, Philippe Preux, Daniil Ryabko.

- *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 à 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. Lampada 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. We consider evolving data. The representation of these data involves 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.

Mohammad Ghavamzadeh and Philippe Preux have collaborated with Hachem Kadri on an operator-based approach for structured output [15].

Daniil Ryabko has developed a theory for unsupervised learning of time-series dependence, where the time series are either coming from a stationary environment or are a result of interaction with a Markovian environment with a continuous state space. Danil Ryabko and Jeremie Mary have developed methods for using binary classification methods for solving various unsupervised learning problems about time series.

### 8.1.2. ANR CO-ADAPT

**Participant:** Rémi Munos.

- *Title:* Brain computer co-adaptation for better interfaces
- *Type:* National Research Agency (ANR-09-EMER-002)
- *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:* 2009-2014
- *Abstract:* The aim of Co-Adapt is to propose new directions for BCI design, by modeling explicitly the co-adaptation taking place between the user and the system. 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:* The performances of a BCI can vary greatly across users but also depend on the tasks used, making the problem of appropriate task selection an important issue. We develop an adaptive algorithm, UCB-classif, based on the stochastic bandit theory. This shortens the training stage, thereby allowing the exploration of a greater variety of tasks. By not wasting time on inefficient tasks, and focusing on the most promising ones, this algorithm results in a faster task selection and a more efficient use of the BCI training session. See [4] and <https://twiki-sop.inria.fr/twiki/bin/view/Projets/Athena/CoAdapt/WebHome>

### 8.1.3. 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 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 has 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) deals with 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 8 months at Master level in 2012 has led us to consider a very fundamental question. Steganalysis is usually proceeded to a classification based on histograms of features (bag of words). We consider the problem of the optimization of the bins of such histograms with respect to the performance of the classifier. We have shown that a balanced version of K-means which fills each cell equally yields an efficient quantization to this respect [28].

#### 8.1.4. National Partners

- Laboratoire de Mathématiques d'Orsay, France.
  - Mylène Maïda *Collaborator*  
Ph. Preux has collaborated with M. Maïda and co-advised a student of the École Centrale de Lille. The motivation of this collaboration is the study of random matrices and the potential use of this theory in machine learning.
- LIF - CMI - Université de Provence.
  - Julien Audiffren *Collaborator*  
M. Valko, A. Lazaric, and M. Ghavamzadeh work with Julien on Semi-Supervised Apprenticeship Learning. We have recently developed a maximum entropy algorithm that outperforms the approach without unlabeled data.
- Laboratoire Lagrange, Université de Nice, France.
  - Cédric Richard *Collaborator*  
We have had collaboration on the topic of *dictionary learning over a sensor network*. We have published 2 conference papers [29] and [10].
- Laboratoire de Mécanique de Lille, Université de Lille 1, France.
  - Jean-Philippe Laval *Collaborator*  
We co-supervise a starting PhD student (Linh Van Nguyen) on the topic of *high resolution field reconstruction from low resolution measurements in turbulent flows*.
- Biophotonics team at the Interdisciplinary Research Institute (IRI), Villeneuve d'Ascq, France.
  - Aymeric Leray *Collaborator*  
We have co-supervised an intern student (Pierre Pfennig, 2 months) on the topic of *quantitative guarantees of a super resolution method via concentration inequalities*. A paper is submitted to ICASSP 2014.
- LAGIS, Ecole Centrale Lille - Université de Lille 1, France.
  - Patrick Bas *Collaborator*  
We have a collaboration on the topic of *adaptive quantization to optimize classification from histograms of features with an application to the steganalysis of textured images*.

## 8.2. European Initiatives

### 8.2.1. FP7 Projects

#### 8.2.1.1. CompLACS

Type: COOPERATION

Defi: Composing Learning for Artificial Cognitive Systems

Instrument: Specific Targeted Research Project

Objectif: Cognitive Systems and Robotics

Duration: March 2011 - February 2015

Coordinator: University College London

Partner:

- Centre for Computational Statistics and Machine Learning, University College London (United Kingdom)
- Department of Computer Science, University of Bristol (United Kingdom)
- Department of Computer Science, Royal Holloway, University of London (United Kingdom)
- SNN Machine Learning, Radboud Universiteit Nijmegen (The Netherlands)
- Institut für Softwaretechnik und Theoretische Informatik, TU Berlin (Germany)
- University of Leoben (Austria)
- Computer Science Department, Technische Universitaet Darmstadt (Germany)

Inria contact: Rémi MUNOS

Website: [COMPLACS](#)

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.

### 8.2.2. Collaborations with Major European Organizations

Alexandra Carpentier: University of Cambridge (UK).

Michal Valko collaborates with Alexandra on extreme event detection (such as network intrusion) with limited allocation capabilities.

Prof. Marcello Restelli and Prof. Nicola Gatti: Politecnico di Milano (Italy).

A. Lazaric continued his collaboration on transfer in reinforcement learning which is leading to an extended version of the last year work on transfer of samples in MDPs. Furthermore, we are going to submit an extended version of an application of multi-arm bandit in a strategic environment such as sponsored search auctions.



## 8.3. International Initiatives

### 8.3.1. Inria Associate Teams

- *Inria principal investigator*: Mohammad Ghavamzadeh and Rémi Munos
  - *Institution*: McGill university (Canada)
  - *Laboratory*: Reasoning and Learning Lab
  - *Principal investigator*:
    - \* Prof. Joelle Pineau *Collaborator*
    - \* Prof. Doina Precup *Collaborator*
    - \* Amir massoud Farahmand *Collaborator*
- *Duration*: January 2013 - January 2015

### 8.3.2. Inria International Partners

#### 8.3.2.1. Declared Inria International Partners

Ronald Ortner and Peter Auer: Montanuniversität Leoben (Austria).

Reinforcement learning (RL) deals with the problem of interacting with an unknown stochastic environment that occasionally provides rewards, with the goal of maximizing the cumulative reward. The problem is well-understood when the unknown environment is a finite-state Markov process. This collaboration is centered around reducing the general RL problem to this case.

In particular, the following problems are considered: representation learning, learning in continuous-state environments, bandit problems with dependent arms, and pure exploration in bandit problems. On each of these problems we have successfully collaborated in the past, and plan to sustain this collaboration possibly extending its scopes.

#### 8.3.2.2. Informal International Partners

- eHarmony Research, California.
  - Václav Petříček *Collaborator*  
Michal Valko has started to collaborate with eHarmony on sequential decision making for online dating and offline evaluation.
- University of Alberta, Edmonton, Alberta, Canada.
  - Csaba Szepesvári and Bernardo Avila Pires *Collaborator*  
We have been collaborating on the topic of *risk bounds in cost-sensitive multiclass classification* this year. We have an accepted paper [8] at ICML.
- Technion - Israel Institute of Technology, Haifa, Israel.
  - Odalric-Ambrym Maillard *Collaborator*  
Daniil Ryabko has worked with Odalric Maillard on representation learning for reinforcement learning problems. It led to a paper in AISTATS [21].
- School of Computer Science, Carnegie Mellon University, USA.
  - Prof. Emma Brunskill *Collaborator*
  - Mohammad Gheshlaghi Azar, PhD *Collaborator*  
A. Lazaric started a profitable collaboration on transfer in multi-arm bandit and reinforcement learning which led to two publications at ECML and NIPS. We are currently working on extensions of the previous algorithms and development of novel regret minimisation algorithms in non-iid settings.
- Technicolor Research, Palo Alto.

- Branislav Kveton *Collaborator*  
Michal Valko and Rémi Munos worked with Branislav on Spectral Bandits aimed at recommendation for the entertainment content recommendation. Michal continued the ongoing research on online semi-supervised learning and this year delivered the algorithm for a challenging single picture per person setting [19]. Victor Gabillon has spent 6 month at Technicolor as an intern to work on the sequential learning with submodularity, which resulted in 1 accepted paper at NIPS and two submissions to ICML.

## **8.4. International Research Visitors**

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

#### *8.4.1.1. Internships*

- Daniele Calandriello, student at Politecnico di Milano, Italy  
Period: since April 2013.  
He is working with A. Lazaric on multi-task reinforcement learning.

### **8.4.2. Visits to International Teams**

- Rémi Munos, since July 2013, Microsoft Research New-England, USA
- Mohammad Ghavamzadeh, since November 2013, Adobe Research, San Jose, CA
- Victor Gabillon visited Technicolor research lab, Palo Alto, from March to September 2013.
- Azadeh Khaleghi visited Walt Disney Animation Studios, Burbank, from March to September 2013.

## **SIMPAF Project-Team**

# **8. Partnerships and Cooperations**

## **8.1. Regional Initiatives**

Collaboration with the laser physics department (PhLAM) of Université Lille 1 (C. Besse, S. De Bièvre, M. Gazeau, and G. Dujardin)

## **8.2. National Initiatives**

### **8.2.1. Collaborations within Inria**

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

### **8.2.2. ANR**

#### **8.2.2.1. ANR IODISSEE (2009-2013)**

**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.

#### **8.2.2.2. 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.

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

**Participant:** Pauline Lafitte.

STAB : 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).

#### 8.2.2.4. ANR BECASIM(2013-2017)

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

C. Besse, G. Dujardin, and I. Lacroix-Violet are members of the new 4-years ANR "Modèles Numériques" project BECASIM. C. Besse is the Toulouse-node coordinator and I. Lacroix-Violet the Lille-node one. The scientific subject deals with mathematical modelling, numerical analysis and simulation of Bose-Einstein condensates (BEC). The goal of this ANR project is to : (i) develop new high-order numerical methods; (ii) develop an integrated and resilient open-source HPC software; (iii) apply these codes to numerically reproduce realistic physical configurations that are not possible to simulate with presently existing software.

### 8.2.3. Competitivity Clusters

#### 8.2.3.1. 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 Molecules (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 3.2.3 and 3.4 .

## 8.3. European Initiatives

### 8.3.1. FP7 Projects

ERC starting grant QUANTHOM (starting February 2014).

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

Felix Otto: Max Planck Institute for Mathematics in the Sciences (Germany)  
Quantitative stochastic homogenization theory.

## **8.4. International Research Visitors**

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

- J.-C. Mourrat (EPFL, 1 week)
- D. Marahrens (MPIMS, 1 week)
- S. Neukamm (WIAS, 1 week)

### **8.4.2. Visits to International Teams**

- A. Gloria, from September to December 2013, Math department, Stanford University

## BONSAI Project-Team

# 7. Partnerships and Cooperations

## 7.1. Regional Initiatives

- Projet émergent call 2011. “Scénarios d’évolution génomique basés sur les régions de cassure des réarrangements génomiques” involving GEPV (UMR CNRS 8198, Université Lille 1) and BONSAI.
- Projet émergent call 2011. “ABILES – Algorithmes bioinformatiques pour le diagnostic de leucémie résiduelle par séquenceurs haut-débit” involving IRCL (Institut de recherche sur le cancer de Lille, Inserm, Université Lille 2), Hematology department of Lille Hospital and BONSAI (see the Vidjil software, Section 5.7).

## 7.2. National Initiatives

### 7.2.1. ANR

- ANR Mappi (2010-2013): National funding from the French Agency Research (call *Conception and Simulation*). This project involves four partners: LIAFA (Université Paris 7), Genescale (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*.
- PIA France Génomique: National funding from Investissements d’Avenir (call *Infrastructures en Biologie-Santé*). France Génomique is a shared infrastructure, whose goal is to support sequencing, genotyping and associated computational analysis, and increase French capacities in genome and bioinformatics data analysis. It gathers 9 sequencing platforms and 8 bioinformatics platforms. Within this consortium, we are responsible for the workpackage devoted to the computational analysis of sRNA-seq data, in coordination with the bioinformatics platform of Génomole Toulouse-Midi-Pyrénées
- Mastodons (2012): National funding from CNRS (call *Scientific big data* ). This call targets the management, analysis and exploitation of massive scientific data sets. We have a collaborative project for Next Generation Sequencing data analysis with LIRMM (Montpellier) and Genscale (Inria Rennes).
- PEPS Bio-Math-Info *Silenes* (2012-2013): National funding from CNRS. This project involves the GEPV (P. Touzet) and the IBMP <sup>8</sup> (J. Gualberto, L. Maréchal-Drouard). The topic is *Etude comparative de l’architecture du génome mitochondrial chez les Caryophyllacées et les Poacées*. It aims to sequence and analyze the genome structure of a number of *Silene* ecotypes and to compare them to other species.
- PEPS Bio-Math-Info *ReSeqVar* (2013-2014): National funding from CNRS. This new project aims at designing new read mapping algorithms in the context of human genome resequencing, taking into account known variants. We are two partners: UMR 8199 (Génomique et maladie métabolique, Ph Froguel, O. Sand, part of the LIGAN sequencing platform) and BONSAI.

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<sup>8</sup>Institut de Biologie Moléculaire des Plantes - UPR2357, Strasbourg

### 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.
- PEPS Biology-Mathematics-Computer science: “Algorithmes pour l’alignement des lectures et la découverte de variants dans les projets de reséquençage”. This project involves two partners: UMR 8199 Génomique et Maladies Métaboliques and BONSAI.

### 7.2.3. ADT

- 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. An engineer was hired from 2011 to 2013 and worked in Rennes and another one was hired in 2012 and works in Lille.

## 7.3. International Initiatives

### 7.3.1. Inria International Partners

#### 7.3.1.1. Informal International Partners

- *Universität Tübingen* : We have a collaboration with Tilmann Weber on the topic of computational biology for nonribosomal peptides. We co-organized a workshop in Lille with him.
- We have a collaboration with Martin C. Frith from the *Computational Biology Research Center* (Tokyo) on the topic of transition spaced seeds.
- *LaCIM (Laboratoire de Combinatoire et d’Informatique Mathématique)*: Since 2009, we have been collaborating with Anne Bergeron (Univ. du Québec à Montréal), Krister Swenson (Univ. de Montréal), and Cédric Chauve (Simon Fraser Univ.) on theoretical and applied aspects of gene orders evolution. In 2011, we began a new project on the analysis of exonic gene structure evolution.
- *Universität Bielefeld (Germany)*: This collaboration started through a PHC Procope bilateral cooperation project with the team of Pr. Robert Giegerich (2010-2011). The goal was to work on a generic parallelization of the Algebraic Dynamic Programming methodology. This partnership is still ongoing, with several visits of Robert Giegerich these last few months. It is the source of our recent work for an extension of Algebraic Dynamic Programming [9].

## 7.4. International Research Visitors

### 7.4.1. Visits of International Scientists

The following scientists visited the team and gave a talk at the team or the laboratory seminar:

- Mihai Pop, University of Maryland (28 may)
- Veli Mäkinen, university of Helsinki (11 december)
- Krister M. Swenson, UQAM (12 november)

## 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, IMAGINE and ASCLEPIOS. The development program of the ADT started in 2007.

### 8.1.2. *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.

### 8.1.3. *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. Since September 2011 a part of our team is located within the IHU, to develop a number of activities in close collaboration with clinicians.

### 8.1.4. *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. European Initiatives

### 8.2.1. FP7 Projects

#### 8.2.1.1. RASimAs

Type: COOPERATION

Defi: NA

Instrument: Specific Targeted Research Project

Objectif: NC

Duration: nov 2012 - oct 2015

Coordinator: RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE (RWTH), Aachen, Germany

Partner: UNIVERSITAETS KLINIKUM AACHEN, Germany // RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE, Germany // BANGOR UNIVERSITY, United Kingdom // UNIVERSITY COLLEGE CORK, NATIONAL UNIVERSITY OF IRELAND, CORK, Ireland // UNIVERSIDAD REY JUAN CARLOS, Spain // FOUNDATION FOR RESEARCH AND TECHNOLOGY HELLAS, Greece // ZILINSKA UNIVERZITA V ZILINE, Slovakia // KATHOLIEKE UNIVERSITEIT LEUVEN, Belgium // SINTEF Norway, SENSEGRAPHICS, Sweden

Inria contact: Stéphane Cotin

Abstract: Regional anaesthesia has been used increasingly during the past four decades. This is addressed to the perceived advantages of reduced postoperative pain, earlier mobility, shorter hospital stay, and significantly lower costs. Current training methods for teaching regional anaesthesia include cadavers, video teaching, ultrasound guidance, and simple virtual patient modeling. These techniques have limited capabilities and do not consider individual anatomy. The goal of this project is to increase the application, the effectiveness and the success rates of RA and furthermore the diffusion of the method through the development VPH models for anaesthesia. The goal of the SHACRA team is to provide the computational infrastructure for the physics-based simulation and to propose new methods for patient-specific modeling and simulation of soft tissues and their interaction with the needle, including its effect on nerve physiology.

## 8.3. International Initiatives

### 8.3.1. Participation In other International Programs

Jeremie Dequidt has been a member of the Inria delegation at the India-France Technology Summit <http://indiafrancesummit.org/>. During a technology showcase, he presented SOFA and various medical simulators. He also was part of a roundtable about biotechnologies.

## **8.4. International Research Visitors**

### ***8.4.1. Visits to International Teams***

Christian Duriez has been invited during one week (last week of October) by the JRL team in AIST Tsukuba Japan, to work with Pr. Eiichi Yoshida on using real-time simulation for the control of robotic tasks with deformable objects.

## ADAM Project-Team

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

### 8.1.1. ADT eSurgeon

**Participants:** Maxime Colmant, Loïc Huertas, Romain Rouvoy [correspondant].

ADT eSurgeon (2013–15) is a technology development initiative supported by the Inria Lille - Nord Europe Center that aims at supporting the development of the POWERAPI software library (see Section 5.3 ) for measuring and monitoring the energy consumption of middleware and software systems.

### 8.1.2. ADT Adapt

**Participants:** Gwenaël Cattez, Philippe Merle [correspondant].

ADT Adapt (2011–13) is a technology development initiative supported by the Inria Lille - Nord Europe Center that 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 5.2 ), *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. Gwenaël Cattez (recent graduated engineer) has been recruited in the context of this ADT.

### 8.1.3. North European Lab SOCS

**Participants:** María Gómez Lacruz, Nicolas Haderer, Christophe Ribeiro, Romain Rouvoy [correspondant], Lionel Seinturier.

North European Lab SOCS (2013–15) is an international initiative supported by the Inria Lille - Nord Europe Center that takes place in the context of a well-established collaboration between Inria and *Universitetet i Oslo* (UiO) initiated in 2008. SOCS focuses on the self-optimization issues in cyber-physical systems. Cyber-Physical Systems (CPS) are complex systems-of-systems that blend hardware and software to fulfill specific missions. However, traditional CPS are statically configured to achieve predefined goals, which not only limit their sharing and their reuse, but also hinder their sustainability. We believe that this waste of resources stems from the lack of agility of CPS to adapt to change in their environment or objectives. The SOCS Inria Lab (Self-Optimization of Cyber-physical Systems) therefore intends to extend the technologies developed as part of the SEAS associate team and more recently the APISENSE platform (see Section 5.1 ) to leverage the development of agile CPS.

### 8.1.4. LEDA

**Participants:** Gwenaël Cattez, Philippe Merle [correspondant].

LEDA (2013–16) Laboratoire d'Expérimentation et de Démonstrations Ambiantes is a demonstration space allocated by the Inria Lille - Nord Europe Center whose goal is to show the scientific results of the ADAM project-team in the domains of distributed systems, adaptable middleware, software product lines, green computing, and ambient computing. These results are illustrated around the scenario of a mock digital home.

- **North European Lab SOCS** (2013–2015) is an international initiative supported by the Inria Lille - Nord Europe Center that takes place in the context of a well-established collaboration between Inria and *Universitetet i Oslo* (UiO) initiated in 2008. SOCS focuses on the self-optimization issues in cyber-physical systems. Cyber-Physical Systems (CPS) are complex systems-of-systems that blend hardware and software to fulfill specific missions. However, traditional CPS are statically configured to achieve predefined goals, which not only limit their sharing and their reuse, but also hinder their sustainability. We believe that this waste of resources stems from the lack of agility of CPS to adapt to change in their environment or objectives. The SOCS Inria Lab (Self-Optimization of Cyber-physical Systems) therefore intends to extend the technologies developed as part of the SEAS associate team and more recently the APISENSE<sup>®</sup> platform (see Section 5.3) to leverage the development of agile CPS.

**Participants:** Maria Gomez Lacruz, Nicolas Haderer, Christophe Ribeiro, Romain Rouvoy, Lionel Seinturier.

## 8.2. National Initiatives

### 8.2.1. ANR SocEDA

**Participants:** Nabil Djarallah, Fawaz Paraïso, Romain Rouvoy, Lionel Seinturier [correspondant].

**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.

### 8.2.2. ANR MOANO

**Participants:** Nabil Djarallah, Laurence Duchien [correspondant], Nicolas Petitprez.

**MOANO** (Models & Tools for Pervasive Applications focusing on Territory Discovery) is a 46-month project of the ANR CONTINT program which started in December 2010. 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.

### 8.2.3. ANR YourCast

**Participants:** Laurence Duchien [correspondant], Clément Quinton, Daniel Romero.

**YourCast** (Software Product Lines for Broadcasting Systems) is a 36-month ANR Emergence project that started in January 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.

#### 8.2.4. *FUI Macchiato*

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

**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 [79].

#### 8.2.5. *FUI EconHome*

**Participants:** Aurélien Bourdon, Rémi Druilhe, Laurence Duchien, Adel Noureddine, Romain Rouvoy, Lionel Seinturier [correspondant].

**EconHome** is a 40-month project funded by FUI and labeled by the Minalogic and Systematic competitiveness clusters. The project started in July 2010. The partners of this project include Sagemcom, Orange, STMicroelectronics, ST-Ericsson, SPiDCOM, Utrema, COMSIS, DOCEA, CEA, ETIS. The project aims at reducing the energy consumption of home and middleware networks. The target is to reduce of at least 70% the energy consumption of devices such as residential gateways, set top boxes, CPL plugs. Two axes are investigated: the optimization of the energy consumption of individual devices with innovative low power and sleep modes, and the optimization of the overall network with innovative techniques, such as service migration and energy aware service feedbacks to the user.

#### 8.2.6. *FUI Hermes*

**Participants:** Laurence Duchien, Romain Rouvoy, Lionel Seinturier [correspondant].

**Hermes** is a 41-month project funded by FUI and labeled by the PICOM (**Pôle des Industries du COMmerce**) competitiveness cluster which has started in August 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-channel, approach to better match customer usages.

#### 8.2.7. *FSN PIA Datalyse*

**Participants:** Filip Křikava, Romain Rouvoy, Lionel Seinturier [correspondant], Bo Zhang.

**Datalyse** is a 36-month project of the FSN Programme Investissement d'Avenir Cloud Computing 3rd call for projects. The project started in May 2013. The partners are Business & Decision Eolas, Groupement des Mousquetaires, Université Grenoble 1, Université Lille 1, Inria, Université Montpellier 2. The project aims at defining an elastic cloud computing infrastructure for processing big volumes of data. The originality of the project is to consider jointly data generated by users and by the infrastructure, and to correlated data at these two levels.

#### 8.2.8. *Inria ARC SERUS*

**Participants:** Laurence Duchien [correspondant], Alexandre Feugas, Lionel Seinturier.

**ARC SERUS** (2011–13) (Software Engineering for Resilient Ubiquitous Systems) is funded 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.

### 8.2.9. Inria ADT AntDroid

**Participants:** María Gómez Lacruz, Nicolas Haderer, Christophe Ribeiro, Romain Rouvoy [correspondant].

ADT AntDroid (2012–14) 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 APISENSE<sup>®</sup> software platform to the public and to support the users of the platform. APISENSE<sup>®</sup> is a distributed platform dedicated to crowd-sensing activities. APISENSE<sup>®</sup> exploits the sensors of mobile devices that are shared by participants to observe physical or behavioral phenomena. The challenges related to the development of such a platform encompasses user privacy and security, battery preservation, and user accessibility.

## 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, Clément Quinton, Daniel Romero [correspondant], Romain Rouvoy, Lionel Seinturier.

Program: FP7 FET

Project acronym: **DIVERSIFY**

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

Duration: 36 months (2013-16)

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 (*Collective Adaptive Systems*). 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 [correspondant], Matias Martinez.

## 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:

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.

**Participants:** Nicolas Haderer, Russel Nzekwa, Daniel Romero, Romain Rouvoy [correspondant], Lionel Seinturier.

## 8.4.2. Inria International Partners

### 8.4.2.1. Declared Inria International Partners

#### 8.4.2.1.1. 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 [86][43] and in the PhD thesis document itself [85].

**Participants:** Laurence Duchien [correspondant], Clément Quinton, Daniel Romero, Romain Rouvoy, Lionel Seinturier.

#### 8.4.2.1.2. University of Oslo, Norway

The scientific collaboration with this international partner deals with complex distributed systems that have to seamlessly adapt to a wide variety of deployment targets. This is due to the fact that developers cannot anticipate all the runtime conditions under which these systems are immersed. A major challenge for these software systems is to develop their capability to continuously reason about themselves and to take appropriate decisions and actions on the optimizations they can apply to improve themselves. This challenge encompasses research contributions in different areas, from environmental monitoring to real-time symptoms diagnosis, to automated decision making. The SEAS associated team (see Section 8.4.1.1) contributes to this collaboration.

**Participants:** Nicolas Haderer, Russel Nzekwa, Daniel Romero, Romain Rouvoy [correspondant], Lionel Seinturier.

### 8.4.2.2. Informal International Partners

#### 8.4.2.2.1. Université du Québec à Montréal

The ADAM project-team has established a new collaboration with UQÀM (*Université du Québec à Montréal*) to improve the software quality of distributed systems. This collaboration has been initiated with a joint PhD thesis (Geoffrey Hecht) that intends to empirically identify design patterns and anti-patterns in Cloud-based applications. The objective of this work is to leverage the development of *Software-as-a-Service* (SaaS) to build modular yet efficient solutions to be deployed in the Cloud.

**Participants:** Laurence Duchien, Geoffrey Hecht, Romain Rouvoy.

## 8.4.3. Participation in Other International Programs

### 8.4.3.1. OW2

**Participants:** Gwenaël Cattez, Philippe Merle [correspondant], Fawaz Paraíso, Romain Rouvoy, Lionel Seinturier.

**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.

### 8.4.3.2. ERCIM Working Group on Software Evolution

**Participant:** Laurence Duchien [correspondant].



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.

## **8.5. International Research Visitors**

### ***8.5.1. Visits of International Scientists***

#### *8.5.1.1. Internships*

Favio Demarco

Subject: Automated Software Repair

Date: from Apr 2013 until Sep 2013

Institution: University of Buenos Aires (Argentina)

Gabriel Moyano

Subject: Crowd-driven Automatic Inference of Traffic Maps

Date: from Mar 2013 until Aug 2013

Institution: University Los Andes (Colombia)

Herman Mekontso

Subject: An SOA Approach for the Design of Information Systems: The Case of the PPR FTH Platform in Central Africa

Date: Oct 2013

Institution: University of Yaoundé (Cameroon)

## FUN Project-Team

# 7. Partnerships and Cooperations

## 7.1. Regional Initiatives

### 7.1.1. Tracaverre

**Participants:** Nathalie Mitton [correspondant], Gabriele Sabatino.

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. National Initiatives

### 7.2.1. ANR

#### 7.2.1.1. RESCUE

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

Title: Reseau Coordonne de substitution mobile

Type: VERSO

Duration: December 2010 - April 2004

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 provides a better service. The base network may be any access network or metropolitan network (including wired and wireless technologies). Troubles may come from an increase of unplanned traffic, a failure of an equipment, or a power outage.

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

### 7.2.1.2. F-Lab

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

Title: Federating Computing Resources

Type: VERSO

Duration: November 2010 - March 2014

Coordinator: UPMC

Other partners: Inria DIANA, DANTE, 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 French top academic and industrial research institutions, working together to develop experimental facilities on the Future Internet. F-Lab presents a unique opportunity for the French community to play a stronger role in the design of federation systems; for the SensLAB testbed to reach an international visibility and use; and for the pioneering of testbeds based on LTE technology.

### 7.2.1.3. 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.

## 7.2.2. ADT

### 7.2.2.1. SenSas

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

Title: Sensor Network Applications (SensAS)

Type: ADT

Duration: November 2010 - November 2014

Coordinator: Inria DANTE

Others partners: Inria Non-A Inria DIANA 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 senstools projects.

#### 7.2.2.2. *SensLille*

**Participants:** Khalil Hammami, Nathalie Mitton [correspondant], 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.

#### 7.2.2.3. *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.

### 7.2.3. *Equipements d'Excellence*

#### 7.2.3.1. *FIT*

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

Title: Future Internet of Things

Type: EquipEx

Duration: March 2010 - December 2019

Coordinator: UPMC

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

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

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

## 7.3. European Initiatives

### 7.3.1. FP7 Projects

#### 7.3.1.1. VITAL

**Participants:** Nathalie Mitton [correspondant], Riccardo Petrolo, Valeria Loscri.

Title: Virtualized programmable InTerfAces for smart, secure and cost-effective IoT depLoymenTs in smart cities

Type: FP7 Smart Cities

Duration: September 2013 - August 2016

Coordinator: National University of Ireland (NUIG), Digital Enterprise Research Institute (DERI)

See also: <http://vital-iot.com/>

Abstract: Internet-of-Things (IoT) applications are currently based on multiple architectures, standards and platforms, which have led to a highly fragmented IoT landscape. This fragmentation is evident in the area of smart cities, which typically comprise several technological silos (i.e. IoT systems that have been developed and deployed independently). Nowadays there is a pressing need to remove these silos in order to allow cities to share data across systems and coordinate processes across domains, thereby essentially improving sustainability and quality of life. In response to this need, VITAL will realize a radical shift in the development, deployment and operation of IoT applications, through introducing an abstract virtualized digital layer that will operate across multiple IoT architectures, platforms and business contexts. Specifically, VITAL will provide platform and business context agnostic access to Internet-Connected-Objects (ICO). Moreover, it will research virtualized filtering, complex event processing (CEP) and business process management mechanisms, which will be operational over a variety of IoT architectures/ecosystems. The mechanisms will compromise the diverse characteristics of the underlying ecosystems, thereby boosting interoperability at the technical and business levels. VITAL will also provide development and governance tools, which will leverage the project's interfaces for virtualized access to ICOs. VITAL will allow solution providers to (re)use a wider range of data streams, thereby increasing the scope of potential applications. It will also enable a more connected/integrated approach to smart city applications development, which will be validated in realistic deployments in London and Istanbul. The partners will contribute and adapt a host of readily available urban infrastructures, IoT platforms and novel IoT applications, which will ease the accomplishment of the project's goals based on an optimal value for EC money.

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

Program: CoperLink

Project acronym: Palmares

Project title: Palmares

Duration: January 2012 - July 2013

Coordinator: Universita degli Studi Mediterranea, Italy

Other partners: Inria, Stellenbosch University (South Africa)

Abstract: Internet of things, VANET and substitution networks.

## 7.4. International Initiatives

### 7.4.1. Inria International Partners

#### 7.4.1.1. Declared Inria International Partners

Currently, the FUN team has two possible International Partners awaiting for approval: Universita mediterranea di Reggio Calabria (UNIC) in Italy and Southern University in China. See next section for details.

#### 7.4.1.2. Informal International Partners

##### **Universita mediterranea di Reggio Calabria (UNIC), Italy**

Objective of this collaboration is the design of an innovative architecture that enables autonomic and decentralized fruition of the services offered by the network of smart objects in many heterogeneous and dynamic environments, in a way that is independent of the network topology, reliable and flexible. The result is an 'ecosystem' of objects, self-organized and self-sustained, capable of making data and services available to the users wherever and whenever required, thus supporting the fruition of an 'augmented' reality thanks to a new environmental and social awareness. This collaboration gave birth to the PALMARES project (see section International programs), students and researchers exchanges (see section international visits) and joint publications, among them for 2013: [16].

##### **Southern University, China**

The purpose of this collaboration is to study the green (or energy-efficient) communication problem in vehicular ad hoc networks (VANETs) and the application of vehicular network communication in green transportation. It gave birth to joint project submission, joint conference organization and several publications, among them for 2013: [34], [36], [38], [13], [26].

##### **PhD co-supervision with Sfax University**

Since January 2013, Nathalie Mitton co-supervises Mouna Rekik as a PhD student with Pr Zied Chtourou from Université de Sfax, Tunisia. Her topic is about swarm intelligence based multi-path geographic routing for wireless sensor and actuator networks.

#### 7.4.2. Inria International Labs

##### 7.4.2.1. PREDNET

**Participants:** Nathalie Mitton [correspondant], Milan Erdelj, Julien Vandaele, Cesar Marchal, Isabelle Simplot-Ryl.

Title: Predator network

Type: LIRIMA

Duration: January 2013 - December 2016

See also: <https://iww.inria.fr/prednet/en/>

Abstract: PREDNET (PREDator adhoc NETwork) proposes to do research on the most suitable topology and subsequent deployment of a wireless sensor network for sparsely populated outlying rural and wilderness areas, for effective monitoring and protection of resources and ecosystems.

This collaboration gave birth to joint project submission, joint conference organization and several publications, among them for 2013: [31]

##### 7.4.2.2. CIRIC Chile

**Participant:** Tahiry Razafindralambo.

Tahiry Razafindralambo is in leave at Inria Chile since August 2013. Tahiry's project within Inria Chile is linked to a project developed by NIC research Labs - Chile (Dr. Javier Bustos, Ms. Carolina Sandoval, Mr. Felipe Lema and Ms. Karina Ventura) regarding Quality of Experience, the Universidad de Chile (Pr. Nelson Baloian and Pr. Gustavo Zurita Alarcon) regarding data display, Psicomédica regarding the clinical aspect regarding the wireless sensor networks aspect. The proposed project tries to evaluate the user perception regarding a wearable monitoring system. The Wearable monitoring system will be installed on patients with mental diseases to monitor their body temperatures, heart rate, ...

## RMOD Project-Team

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

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

## 8.2. National Initiatives

### 8.2.1. ANR

#### 8.2.1.1. Cutter

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

## 8.3. European Initiatives

### 8.3.1. 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>.

### 8.3.2. 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.

### 8.3.3. MEALS FP7 Marie Curie Research Staff Exchange Scheme

MEALS (Mobility between Europe and Argentina applying Logics to Systems) is a mobility project financed by the 7th Framework programme under Marie Curie's International Research Staff Exchange Scheme. It involves seven academic institutions from Europe and four from Argentina, and a total of about 80 researchers to be exchanged. The project started on the 1st of October, 2011, and it has a duration of 4 years. Nr: FP7-PEOPEL-2011-IRSES

<http://www.meals-project.eu>

Visits in the context of MEALS

- Guido Chari visited RMoD from 29/11/2013 to 22/12/2013
- Diego Garbervetsky visited RMoD from 16/12/2013 to 17/12/2013
- Camillo Bruni visited UBA (Buenos Aires, Argentina): 2012-09-01 - 2012-09-30

## 8.4. International Initiatives

### 8.4.1. Inria Associate Teams

#### 8.4.1.1. 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 [50]. 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 [52]. 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 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.

2013 was the third and final year of PLOMO. Due to the success of PLOMO, we have requested a prolongation for another three years (PLOMO2). The *PLOMO Associate Team Final Report* is available online [37].

In the following, we present the results from 2013:

#### Research Visits From RMoD to PLEIAD

- Stéphane Ducasse from November 4 until November 15, 2013.

#### From PLEIAD to RMoD

- Johan Fabry on 15th of July, 18th and 19th of September 2013
- Alexandre Bergel from December 12 until December 29, 2013
- Alejandro Infante from September 13 until September 21, 2013
- Ronie Salgado in January 2014

#### Recent Results



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

- GradualTalk Paper accepted at Science of Computer Programming.
- Performance Evolution Blueprint paper at VISSOFT.
- Work on the DIE domain-specific language and the definition of IDE plugins using it was submitted to a journal and is in a second round of revisions.
- Organization of a coding sprint at Santiago in January 2013 (12 participants)
- Participated to three Moose releases (4.7-4.9) (<http://www.moosetechnology.org>)
- Integrated the Opal Compiler in the Pharo3 development branch.

**Future of the Partnership** We really hope that the team will be prolonged for a second three year period. The synergy between the two teams is working really well - in terms of exchanges, results and future collaborations.

For more information, we refer to the report *PLOMO Associate Team Final Report* [37].

## 8.4.2. Inria International Partners

### 8.4.2.1. Uqbar - Argentina

**Participants:** Marcus Denker [correspondant], Stéphane Ducasse [RMoD], Nicolas Anquetil [RMoD], Diego Garbervetsky [UBA,LAFHIS], Gabriela Arevalo [Universidad Nacional de Quilmes]), Nicolas Passerini [Uqbar].

Uqbar is a foundation of researchers teaching in several universities of the Buenos Aires area. Universidad Tecnologica Nacional (FRBA) Universidad Nacional de Quilmes, Universidad Nacional de San Martin, Universidad Nacional del Oeste. LAFHIS is a research laboratory from the University of Buenos Aires. More information at (<http://www.uqbar-project.org>).

### 8.4.2.2. Informal International Partners

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.

## 8.4.3. Participation In other International Programs

### 8.4.3.1. 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 lasted 24 months and ended June 2013.

## 8.5. International Research Visitors

### 8.5.1. Visits of International Scientists

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

- Johan Fabry on 15th of July, 18th and 19th of September 2013
- Alexandre Bergel from December 12 until December 29, 2013
- Alejandro Infante from September 13 until September 21, 2013
- Ronie Salgado in January 2014

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

- Marco Tulio Valente from 21/01/2013 to 25/01/2013
- Marco Tulio Valente from 22/07/2013 to 26/07/2013

In the context of MEALS:

- Guido Chari visited RMoD from 29/11/2014 to 22/12/2013.
- Diego Garbervetsky visited RMoD 16 and 17 December.

Other visitors:

- Hani Abdeen, Research Associate at Computer Science Department - Qatar University (January 2013)
- Michele Lanza, Professor at the University of Lugano (2nd of May, 2013)
- Hayatou Oumarou, Assistant Departement d'Informatique ENS Maroua Cameroun (March 2013 for 1 Month)
- David Chisnall, Research Associate at University of Cambridge, (4-5 February)
- Tommaso Dal Sasso, University of Lugano, (16-22 December)
- Yuriy Tymchuk, University of Lugano, (16-22 December)
- Roberto Minelli, University of Lugano, (16-22 December)
- Andrei Vasile, University of Bern, Switzerland (18-21 December)
- Jan Kurs, University of Bern, Switzerland, (18-21 December)

#### 8.5.1.1. Internships

**Pablo Herrero**, University of Buenos Aires (Argentina): *Compressed ASTs for Pharo*, from Oct 2013.

**Sebastian Tleye**, University of Buenos Aires (Argentina): *A new Trait Implementation*, from Mar until Aug 2013.

**Gustavo Jansen De Souza Santos**, Federal University of Minas Gerais (Brasil): *Integration of Semantic Clustering in Moose*, September until November 2013.

**Gisela Decuzzi**, Universidad Tecnológica Nacional FRBA (Argentina): *AST Navigation for Pharo*, from March to May 2013.

**Yuriy Tymchuk**, Ivan Franko National University of Lviv (Ukraine): *Extending FAMIX metamodel to generate ASTs for Java and Smalltalk applications*, from January to April 2013.

**Erwan Douaille**, University of Lille 1: *Automatic validation of contributions from Pharo community*, From April to Jun 2013

#### 8.5.2. Visits to International Teams

- Stéphane Ducasse from November 4 until November 15, 2013. (PLOMO).
- Stéphane Ducasse from November to University of Buenos Aires (Argentina) (MEALS).
- Stéphane Ducasse and Igor Stasenko visited the University of Lviv, Ukraine.
- Camillo Bruni visited UBA (Buenos Aires, Argentina): September (1 Month)
- Marcus Denker visited *Universitat Politècnica de Catalunya*, Barcelona, Spain, 1 week in October 2013.
- Stéphane Ducasse visited the University of Prag for one week in December, 2013

## LINKS Team

# 7. Partnerships and Cooperations

## 7.1. Regional Initiatives

### 7.1.1. FUI Région AAP 14 Hermes (2013-2015)

**Participants:** Angela Bonifati [correspondent], Joachim Niehren, Iovka Boneva, Denis Debarbieux.

The Hermes project on “Relation Client Personnalisée et Contextualisée” is coordinated by Bonifati from Links. Our partners are the Université Lille 1, Logos Keyneosoftware, Cylande, Norsys, NumSight, Leroy Merlin, Kiabi and Auchan.

The project addresses the problem of enriching the client communication within the marketing process. Starting from heterogeneous data sources (connected devices, social networks and traditional marketing channels), one has to extract the necessary information at hand. The data sources can be seen in a streaming fashion as they produce continuous data.

## 7.2. National Initiatives

### 7.2.1. Competitiveness Clusters

We participate to the following <http://www.picom.fr/> (Pôle de compétitivité PICOM - regional research cluster on commerce industries). In particular, the Hermes project has been conceived within the cluster.

## 7.3. International Initiatives

### 7.3.1. Inria International Partners

#### 7.3.1.1. Declared Inria International Partners

We have submitted a proposal for an Inria North-European Lab Lille-Oxford, which has been accepted. The main people involved are Joachim Niehren (leader), Pierre Bourhis and Angela Bonifati, but the cooperation is equally relevant for Iovka Boneva, Aurélien Lemay, Slawek Staworko, Sophie Tison, Radu Ciucanu (PhD student). The Oxford database group (<http://www.cs.ox.ac.uk/isg/db>) is one of the top database groups world wide. The main persons involved will be Michael Benedikt (leader), Dan Olteanu, Andreas Pieris (postdoc). Further promising cooperation opportunities are to be explored with members of Georg Gottlob's ERC project DiaDem (<http://www.cs.ox.ac.uk/projects/DIADEM/index.html>) on semantics-based information extraction.

## 7.4. International Research Visitors

### 7.4.1. Visits of International Scientists

Tova Milo (Tel-Aviv University, Israel) visited the team in February 2013 for one day.

Amr El Abbadi (UCSB, Usa) visited the team in March 2013 for one day.

Jan van den Bussche (Hasselt University, Belgium) visited the team in November 2013 for two days.

### 7.4.2. Visits to International Teams

Pierre Bourhis visited the Oxford database group (<http://www.cs.ox.ac.uk/isg/db>) for three weeks in October, November and December 2013.

## MAGNET Team

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

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

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

PASCAL DENIS and MARC TOMMASI supervise the PhD thesis of DAVID CHATEL on semi-supervised 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, Fabien Torre, Gemma Casas 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/>.

### 8.2.2. *Competitivity Clusters*

We are part of FUI HERMES (2012-2015), a 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*

Program: ERC Advanced Grant

Project acronym: STAC

Project title: Strategic conversation

Duration: Sept. 2011 - Aug. 2016

Coordinator: Nicholas Asher, CNRS, Université Paul Sabatier, IRIT (France)

Other partners: School of Informatics, Edinburgh University; Heriot Watt University, Edinburgh

Abstract: STAC is a five year interdisciplinary project that aims to develop a new, formal and robust model of conversation, drawing from ideas in linguistics, philosophy, computer science and economics. The project brings a state of the art, linguistic theory of discourse interpretation together with a sophisticated view of agent interaction and strategic decision making, taking advantage of work on game theory.

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

## MINT Project-Team

# 7. Partnerships and Cooperations

## 7.1. National Initiatives

### 7.1.1. *InSTInCT (ANR ContInt, 2009-2013)*

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

This project focused 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/>

### 7.1.2. *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, Univ. Lille 1, Inria, Orange Labs, CNRS, EASii IC, MENAPIC and ALPHAUI.

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

### 7.1.3. *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)

## 7.2. International Research Visitors

### 7.2.1. *Visits of International Scientists*

Short visits:

- **Michael Terry** (University of Waterloo, Canada) in June
- **Andy Cockburn** (University of Canterbury, New Zealand) in July
- **Karan Singh** (University of Toronto, Canada) in December

### 7.2.2. *Visits to International Teams*

F. Giraud was invited researcher at the electrical and computer engineering department of the University of Toronto (Ontario, Canada). He was granted with the sabbatical program of the international relations (september 2012, july 2013).