



RESEARCH CENTER

FIELD

Activity Report 2012

Section Contracts and Grants with Industry

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BYMOORE Exploratory Action

5. Bilateral Contracts and Grants with Industry

5.1. Grants with Industry

- **ANR MHANN** (Memristive Hardware Artificial Neural Networks Accelerators): The purpose of this project is to build a medium scale prototype of such a bio inspired architecture, by using long life and nanometric-ferroelectric memristors. The area, performance and power benefits of this approach will be evaluated to define its interest for embedded systems. The MHANN project is multi disciplinary in the sense that it proposes new physical concepts for devices (physics) and aims at integrating them into on chip bio inspired architectures (micro electronics, computer science and architectures).
- **ANR NEMESIS** (NEuroMorphic hardwarE for Smart vIsion Sensor): This project aims at exploring the potential of biologically-inspired spike-based image processing supported by the realization of massively parallel yet scalable hardware thanks to 3D stacking of integrated circuits.
- **ANR Arch2Neu** (Neuromorphic hardware and software environment for versatile computing): Arch2Neu aims at investigating the potential of neuromorphic architectures for computing purposes, and particularly for signal-processing applications. We develop analog neural hardware, interconnections architectures, libraries, and compilers to provide to the user a versatile and efficient computing machine. You can learn more about our research through the dedicated webpages.

5.2. European Initiatives

5.2.1. FP7

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

5.3. International Initiatives

5.3.1. Inria Associate Teams

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

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

5.3.2. Visits of International Scientists

- Jing Huang sent by ICT and Chinese Academy of Science for 12 months in France, for cooperation on reconfigurable accelerator.

5.3.3. Visits to International Teams

- Numerous stays in China by Olivier Temam (about once per month on average).

5.3.4. Participation In International Programs

- **YOUHUA at LIAMA:** LIAMA is (originally) an Inria-Chinese Academy of Sciences lab (now Europe-China CS lab), and we just established a joint team at LIAMA, also called YOUHUA. Unlike YOUHUA, this joint team is Inria-ICT-EPFL. The goal is both the design of reconfigurable accelerators, and programming approaches for heterogeneous multi-cores.
- **Joint lab with ICT.** Set up of a joint lab with ICT, Beijing, China on *Accelerators for Emerging Applications*.

POPIX Exploratory Action

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

POPIX has a contract with Astrazeneca (November 2011 - November 2014)

POPIX has a contract with LIXOFT (June 2011 - June 2013)

ABSTRACTION Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contracts with Industry

7.1.1. License agreement

7.1.1.1. Astrée

In February 2009 was signed an exploitation license agreement between CNRS, École Normale Supérieure, and **AbsInt Angewandte Informatik GmbH** for the industrialization of the **ASTRÉE** analyzer. **ASTRÉE** is commercially available from **AbsInt** since January 2010. Continuous work goes on to adapt the **ASTRÉE** static analyzer to industrial needs, in particular for the automotive industry. Radhia Cousot is the scientific contact.

7.2. Grants with Industry

7.2.1. FNRAE projects

7.2.1.1. Ascet

Title: Analyses Statiques CERTifiés

Type: 6th call: Verification methods for software and systems

Instrument: FNRAE grant

Duration: April 2009 - March 2012

Coordinator: Inria (France)

Others partners: Inria-Bretagne Atlantique, the Inria Rhône-Alpes, the Inria Paris-Rocquencourt, and the ENS.

See also: <http://ascert.gforge.inria.fr/>

Abstract: Although static analyzers have demonstrated their ability to prove the absence of large classes of errors in critical software, they are themselves large and complex software, so it is natural to question their implementation correctness and the validity of their output. The focus of the **ASCERT** project is the use of formal methods to ensure the correctness of an analyzer with respect to the abstraction interpretation theory. Methods to be investigated include the direct proof of the analyzer, the proof of a verifier for the analyzer result, and the validation of the inductive invariants generated by the analyzer, using the Coq proof assistant. These methods will be applied to the certification of several numerical abstract domains, of an abstract interpreter for imperative programs and its possible extensions to one of the formal semantics of the CompCert verified C compiler.

7.2.1.2. Sardanes

Title: Sémantique, Analyse et tRansformation Des Applications Numériques Embarqués Synchrones

Type: 6th call: Verification methods for software and systems

Instrument: FNRAE grant

Duration: February 2009 - September 2012

Coordinator: Université de Perpignan

Others partners: Université de Perpignan and the ENS.

See also: <http://perso.univ-perp.fr/mmartel/sardanes.html>

Abstract: SCADE is widely used to write critical embedded software, as a specification and verification language. The semantics of SCADE uses real arithmetics whereas it is compiled into a language that uses floating-point arithmetics. The goal of the **SARDANES** project is to use expression transformation so as to ensure that the numerical properties of the programs is preserved during the compilation. Patrick Cousot and Radhia Cousot are the principal investigators for this action.

ALF Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Intel Research Grant

Participant: André Seznec.

Intel is supporting the research of the ALF project-team on "Alternative ways for improving uniprocessor performance".

AOSTE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Thales ARCADIA/Melody

Participants: Frédéric Mallet, Robert de Simone.

In the remote context of ARTEMIS CESAR [8.3.1.1](#) we conducted a specific study of the functional expressiveness of the ARCADIA/Melody environment, developed and deployed internally inside several Thales divisions. A questionnaire was designed by us, according to the various semantic variation points that we identified into this Model-Driven Engineering (MDE) environment. It was then sent to potential users for feedback, and reporting was done together with colleagues from Thales TRT (R&D division) to their management. As a result a number of non-trivial redesign decisions were taken. Our findings were presented through a number of focused meetings held at Thales in the Saclay technopark. While most work was performed at this stage on purely data-flow functional description diagrams, there is an interest inside the company to extend this type of critical survey analysis to extended description models, including event-based control and modes.

ARIC Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. STMicroelectronics CIFRE PhD Grant

Jingyan Jourdan-Lu was supported by a CIFRE PhD grant (from March 2009 to September 2012) from STMicroelectronics (Compilation Expertise Center, Grenoble) on the theme of floating-point arithmetic code generation and specialization for embedded processors. Advisors: Claude-Pierre Jeannerod and Jean-Michel Muller (AriC), Christophe Monat (STMicroelectronics). A contract between STMicroelectronics and Inria (duration: 36 months; amount: 36,000 euros; signature: fall 2010) aimed at supporting the developments done in the context of this PhD, defended 2012/11/15.

7.1.2. Kalray CIFRE PhD Grant

Nicolas Brunie is supported by a CIFRE PhD grant (from 15/04/2011 to 14/04/2014) from Kalray. Its purpose is the study of a tightly-coupled reconfigurable accelerator to be embedded in the Kalray multicore processor. Advisors: Florent de Dinechin (Arénaire) and B. de Dinechin (Kalray). The support contract between Kalray and Inria amounts to 76,000 euros on three years.

7.1.3. Intel Donation

Intel is making a donation of 20,000\$ to AriC to support research around the automatic construction of libm functions.

ATEAMS Project-Team (section vide)

CAIRN Project-Team (section vide)

CAMUS Team (section vide)

CAMEL Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Training and consulting with HTCS

Participants: Pierrick Gaudry, Emmanuel Thomé [contact].

We have a one-year contract with the HTCS company, for training and consulting activities, on topics related to our research. This contract is likely to be renewed in 2013.

CARTE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

We are currently working with the consortium “malware.lu”.

CASCADE Project-Team (section vide)

CASSIS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Research Result Transfer

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

CELTIQUE Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Project with FIME

Participants: Thomas Jensen, Frédéric Besson, David Pichardie, Delphine Demange, Vincent Monfort, Pierre Vittet.

Static program analysis, Javacard, Certification, AFSCM

- Partner : **FIME**
- Period: Starting January 2012; ending February 2013

The FIME contract consists in an industrial transfer of the Sawja platform 4.2 adapted to analyse Javacard programs according to **AFSCM** (Association Française du Sans Contact Mobile) security guidelines. The outcome of the project is the Jacal (JAvaCard AnaLyser) (4.3).

6.2. The FRAE ASCERT project

Participants: Frédéric Besson, Sandrine Blazy, David Cachera, Thomas Jensen, David Pichardie, Pierre-Emmanuel Cornilleau.

Static program analysis, Certified static analysis

The ASCERT project (2009–2012) is founded by the *Fondation de Recherche pour l'Aéronautique et l'Espace*. It aims at studying the formal certification of static analysis using and comparing various approaches like certified programming of static analysers, checking of static analysis result and deductive verification of analysis results. It is a joint project with the Inria teams ABSTRACTION, GALLIUM and POP-ART.

COMETE Project-Team (section vide)

COMPSYS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Mediacom Project with STMicroelectronics

Participants: Benoit Boissinot, Florian Brandner, Quentin Colombet, Alain Darte, Fabrice Rastello.

This contract has started in September 2009 as part of the funding mechanism Nano2012. This is the continuation of the successful previous project Sceptre with STMicroelectronics, which ended in December 2009. Mediacom concerned both aggressive optimizations and the application of the previously-developed techniques to JIT compilation. The project ended this year. Quentin Colombet, whose PhD was funded by this project, defended his PhD in December 2012 [1].

7.2. Creation of the Zettice Start-Up

Participants: Christophe Alias, Alexandru Plesco [Compsys/Zettice].

Following his PhD, Alexandru Plesco initiated a start-up on high-level synthesis for FPGAs, named Zettice, and based on the use and extension of tools/techniques developed in Compsys (for high-level code transformations) and Arénaire (for the development of pipelined operators). The results described in Sections 5.7 , 5.8 , 5.9 , and 6.4 are directly linked to this effort.

The incubation of Zettice is supported by Crealys, the “Région Rhône-Alpes”, and Inria: Alexandru Plesco is “ingénieur technologie and innovation” (ITI) since October 2011. Zettice should be created around April 2013. Christophe Alias is in charge of the scientific collaboration between Compsys and Zettice.

7.3. ManyCoreLabs with Kalray

Compsys is part of ManyCoreLabs, an academic/industrial project, coordinated by Kalray, a multi-core french company. The project is funded by a “Investissement d’Avenir”/BGLE (“Briques génériques du logiciel embarqué”) grant. The goal of this project is to help the Kalray company, based on a collaboration with several partners, to become the European leader of the market of many-core chips for embedded systems. Industrial partners of this project include Bull, CAPS Entreprise, Digigram, Thales, Renault. Academic partners include CEA, Inria (Parkas and Compsys teams), VERIMAG.

CONTRAINTES Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Dassault-Systèmes, BioIntelligence project

- The OSEO **Biointelligence** project coordinated by Dassault-Systèmes, with EPI Orpailleur, Sobios, Aureus pharma, Ipsen, Pierre Fabre, Sanofi-Aventis, Servier, Bayer CropScience, INSERM, Genopole Evry (2009-2014).

7.2. KLS-Optim, Rules2Optim project

- DTI ITI support for the industrialization of our Rules2CP software and technological transfer to SME KLS-Optim (2011-2013).

7.3. General Electric Transportation, Cifre contract

- Cifre PhD accompanying contract with General Electric Transportation on urban railway time tabling optimization (2011-2014).

CONVECS Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

Participants: Hubert Garavel, Abderahman Kriouile, Radu Mateescu, Wendelin Serwe.

Abderahman Kriouile is supported by a CIFRE PhD grant (from March 2012 to March 2015) from STMicroelectronics (Grenoble) on the verification of cache coherency in systems on chip, under the supervision of Grégory Faux and Massimo Zendri (STMicroelectronics), Radu Mateescu and Wendelin Serwe (CONVECS).

DART Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Collaboration EADS IW, and Eurocopter

The subject deals with dynamic reconfigurable system design for avionic test applications. It is motivated by the need of methodologies and tools for the design of high-performance applications on dynamic reconfigurable computing systems. A complete methodology takes the reconfigurability of the hardware as an essential design concept and proposes the necessary mechanisms to fully exploit those capabilities at runtime. A set of tools must provide high-quality designs with improved designer productivity, which guarantees consistency with the initial requirements for adaptability and for the final implementation. This methodology allows designers to easily implement a system specification on a platform that includes general purpose processors dynamically combined with multiple accelerators running on an FPGA.

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. ANR Famous

Collaboration with Inria Rhône Aples, Université de Bretagne Sud, Université de Bourgogne, SME SODIUS

FAMOUS project aims at introducing a complete methodology that takes the reconfigurability of the hardware as an essential design concept and proposes the necessary mechanisms to fully exploit those capabilities at runtime. The project covers research in system models, compile time and run time methods, and analysis and verification techniques. These tools will provide high-quality designs with improved designer productivity, while guaranteeing consistency with the initial requirements for adaptability and the final implementation. Thus FAMOUS is a research project with an immediate industrial impact. Actually, it will make reconfigurable systems design easier and faster. The obtained tool in this project is expected to be used by both companies designers and academic researchers, especially for modern applications system specific design as smart camera, image and video processing, FAMOUS tools will be based on well established standards in design community. In fact, modeling will start from very high abstraction level using an extended version of MARTE. Simulation and synthesizable models will be obtained by automatic model to model transformations, using MDE approach. These techniques will contribute to shorten drastically time-to-market. FAMOUS is a basic research project. In fact, most of partners are academic, and its main objective is to explore novel design methodologies and target modern embedded systems architectures. FAMOUS project is funded by french Agence Nationale de la Recherche (ANR). It has also been labeled by Media & Network cluster in 2009. The involved resources reach 408 person-month, from five partners: the public research labs LIFL Inria (Lille), LabSTICC (Lorient), Inria Rhône-Alpes (Grenoble), LE2I University of Bourgogne (Dijon) and the SME company Sodius SAS (Nantes). It has started on December 2009, and it will last 48 months.

7.2.1.2. The ANR Open-People project

Partners: Université de Bretagne Sud (UBS)Lab-STICC, Inria Nancy Grand Est, Inria Lille Nord Europe, Université de Rennes 1 (UR1), Université de Nice Sophia Antipolis (UNSA), THALES Communications (Colombes), InPixal (Rennes)

The Open-PEOPLE (Open Power and Energy Optimization PLatform and Estimator project is a national project funded by the ANR (Agence Nationale de la Recherche), the French National Research Agency. The objective of Open-PEOPLE is to provide a platform for estimating and optimizing the power and energy consumptions. Users will be able to estimate the consumption of an application deployed on a hardware architecture chosen in a set of parametric reference architectures. The components used in the targeted architecture will be chosen in a library of hardware and software components. Some of these components will be parametric (such as reconfigurable processors or ASIP) to further enlarge the design space for exploration. The library will be extensible; users will have the possibility to add new components, according to the evolution of both applications and technology. Open-PEOPLE is definitely an open project. The software platform for conducting estimation and optimization, will be accessible through an Internet portal. This software platform will be coupled to an automated hardware platform for physical measurements. The measurements needed to build models for new components to be added in the library will be remotely controlled through the software platform. A library of benchmarks will be proposed, to help building models for new components and architectures.

7.2.2. Competitivity Clusters

We collaborate with the L2EP (Université de Lille1) inside the research pole MEDEE, especially in the first action: industrialization of Code_CARMEL.

7.2.3. Within Inria

We collaborate with colleagues within Inria with the Triskell team at Inria Rennes-Bretagne Atlantique) on the analysis of DSMLs and on the formal definition of Kermeta.

DEDUCTEAM Team (section vide)

ESPRESSO Project-Team (section vide)

FORMES Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

We obtained a contract of 100 000 Chinese RMB (12 500 Euros) with Nokia Research Center in Beijing to study formal proofs of security API's in Android mobile phones.

GALAAD Project-Team (section vide)

GALLIUM Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. The Caml Consortium

Participants: Xavier Leroy [correspondant], Xavier Clerc, Damien Doligez, Didier Rémy.

The Caml Consortium is a formal structure where industrial and academic users of Caml can support the development of the language and associated tools, express their specific needs, and contribute to the long-term stability of Caml. Membership fees are used to fund specific developments targeted towards industrial users. Members of the Consortium automatically benefit from very liberal licensing conditions on the OCaml system, allowing for instance the OCaml compiler to be embedded within proprietary applications.

The Consortium currently has 12 member companies: CEA, Citrix, Dassault Aviation, Dassault Systèmes, Esterel Technologies, Jane Street, LexiFi, Microsoft, MLstate, Mylife.com, OCamlPro, and SimCorp.

For a complete description of this structure, refer to <http://caml.inria.fr/consortium/>. Xavier Leroy chairs the scientific committee of the Consortium.

GEOMETRICA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. Geometry Factory

The initial development phase of the CGAL library has been made by a European consortium. In order to achieve the transfer and diffusion of CGAL in the industry, a company called GEOMETRY FACTORY has been founded in January 2003 by Andreas Fabri (<http://www.geometryfactory.com>).

The goal of this company is to pursue the development of the library and to offer services in connection with CGAL (maintenance, support, teaching, advice). GEOMETRY FACTORY is a link between the researchers from the computational geometry community and the industrial users.

It offers licenses to interested companies, and provides support. There are contracts in various domains such as CAD/CAM, medical applications, GIS, computer vision...

GEOMETRY FACTORY is keeping close contacts with the original consortium members, and in particular with GEOMETRICA.

In 2012, GEOMETRY FACTORY had the following new customers for CGAL packages developed by GEOMETRICA: Archivideo (GIS, 2D Constrained Delaunay), Gamesim (games, 2D Constrained Delaunay), Medicm (medical imaging, 2D Constrained Delaunay, BE), Tecosim(CAD/CAM, 3D Delaunay, Germany). Midland Valley (Surface mesher, UK)

Moreover, research licenses (in-house research usage for all of CGAL) have been purchased by: ROI Bologna (medical imaging, Italy), Technicolor (France), U Southampton (medical imaging, UK), ZIB (medical imaging, Germany).

7.1.2. Astrium

Participants: Pierre Alliez, Florent Lafarge, Sven Oesau.

The main goal of this collaboration is to develop indoor models more accurate, meaningful and complete than existing methods. The conventional way for modeling indoor scenes is based on plane arrangements. This type of representation is particularly limited and must be improved by developing more complex geometric entities adapted to a detailed and semantized description of scenes.

- Starting date: April 2012

- Duration: 3 years

7.2. National Initiatives

7.2.1. ADT CGALmesh

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

In collaboration with Jane Turnois from Geometry Factory.

CGALmesh is an Inria technological development action started in March 2009, in collaboration with Geometry Factory. Building upon components from CGAL, we are implementing a generic mesh generation framework for surfaces and 3D domains. We primarily target applications which involve data acquired from the physical world: geology, medicine, 3D cartography and reverse engineering. In 2012 we devised a new parallel 3D mesh generation and optimization algorithm for multi-core architectures with shared memory, and an algorithm for anisotropic mesh generation.

- Starting date: March 2009

- Duration: 3 years

7.2.2. ANR *Présage*

Participants: Olivier Devillers, Marc Glisse, Ross Hemsley, Monique Teillaud, Rémy Thomasse.

Web site: <http://webloria.loria.fr/~goaoc/ANR-Présage/>

We participate in the PRÉSAGE project funded by the ANR. The project involves:

- the Inria VEGAS team,
- Univeristy of Rouen, and
- the GEOMETRICA team.

This project brings together computational and probabilistic geometers to tackle new probabilistic geometry problems arising from the design and analysis of geometric algorithms and data structures. We focus on properties of discrete structures induced by or underlying random continuous geometric objects. This raises questions such as:

- What does a random geometric structure (convex hulls, tessellations, visibility regions...) look like?
- How to analyze and optimize the behavior of classical geometric algorithms on *usual* inputs?
- How can we generate randomly *interesting* discrete geometric structures?

- Starting date: 31 December 2011

- Duration: 4 years

- Year publications: [55], [50], [57].

7.2.3. ANR *GIGA*

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

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

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

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

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

- Starting date: October 2009.

- Duration: 4 years.

7.2.4. *DIGITEO Chair C3TTA: Cell Complexes in Computational Topology: Theory and Applications*

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

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

- Starting date: January 2009.

- Duration: 3 years.

7.2.5. *GDR ISIS young researcher project on "scene analysis from Lidar"*

Participant: Florent Lafarge.

The GDR ISIS young researcher project on "scene analysis from Lidar" consists in reconstructing in 3D large-scale city models from airborne Lidar scans. This project is in collaboration with Clément Mallet and Bruno Vallet from MATIS Laboratory, IGN [<http://www.ign.fr>].

- Starting date: January 2010

- Duration: 3 years

7.2.6. *Grand emprunt Culture 3D Clouds*

Participants: Pierre Alliez, Florent Lafarge, Thijs van Lankveld.

Culture 3D Clouds is a cloud computing platform for 3D scanning, documentation, preservation and dissemination of cultural heritage. The motivation stems from the fact that the field of 3D scanning artifacts heritage evolves slowly and only provides resources for researchers and specialists. The technology and equipment used for 3D scanning are sophisticated and require highly specialized skills. The cost is thus significant and limits the widespread practice. Culture 3D Clouds aims at providing the photographers with a value chain to commercialize 3D reproductions demand for their customers and expand the market valuation of business assets (commercial publishers, general public).

- Starting date: September 2012

- Duration: 3 years

7.3. European Initiatives

7.3.1. *FP7 Projects*

7.3.1.1. *CG-Learning*

Title: Computational Geometric Learning

Type: COOPERATION (ICT)

Defi: FET Open

Instrument: Specific Targeted Research Project (STREP)

Duration: November 2010 - October 2013

Coordinator: Friedrich-Schiller-Universität Jena (Germany)

Others partners: National and Kapodistrian University of Athens (Greece), Technische Universität Dortmund (Germany), Tel Aviv University (Israel), Eidgenössische Technische Hochschule Zürich (Switzerland), Rijksuniversiteit Groningen (Netherlands), Freie Universität Berlin (Germany)

See also: <http://cgl.uni-jena.de/>

Abstract: The Computational Geometric Learning project aims at extending the success story of geometric algorithms with guarantees to high-dimensions. This is not a straightforward task. For many problems, no efficient algorithms exist that compute the exact solution in high dimensions. This behavior is commonly called the curse of dimensionality. We try to address the curse of dimensionality by focusing on inherent structure in the data like sparsity or low intrinsic dimension, and by resorting to fast approximation algorithms.

7.3.1.2. ERC IRON

Title: Robust Geometry Processing

Type: IDEAS

Instrument: ERC Starting Grant (Starting)

Duration: January 2011 - December 2015

Coordinator: Pierre Alliez, Inria Sophia Antipolis - mediterranee (France)

See also: <http://www-sop.inria.fr/geometrica/collaborations/iron/>

Abstract: The purpose of this project is to bring forth the full scientific and technological potential of Digital Geometry Processing by consolidating its most foundational aspects. Our methodology will draw from and bridge the two main communities (computer graphics and computational geometry) involved in discrete geometry to derive algorithmic and theoretical contributions that provide both robustness to noisy, unprocessed inputs, and strong guarantees on the outputs. The intended impact is to make the digital geometry pipeline as generic and ironclad as its Digital Signal Processing counterpart.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. COMET

Title: Computational Methods for the analysis of high-dimensional data

Inria principal investigator: Steve Y. Oudot

International Partner:

Institution: Stanford University (United States)

Laboratory: Computer Science Department

Researcher: Leonidas J. Guibas

International Partner:

Institution: Ohio State University (United States)

Laboratory: Computer Science and Engineering

Researcher: Yusu Wang

Duration: 2011 - 2013

See also: <http://geometrica.saclay.inria.fr/collaborations/CoMeT/index.html>

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

7.4.2. Visits of International Scientists

7.4.2.1. Exterior research visitors

Misha Belkin (Ohio State University).

Mikhail Bessmeltsev (University of British Columbia).

Mark Blome (Zuse-Institut Berlin).

Benjamin Burton (School of Mathematics and Physics, University of Queensland, Brisbane).

Dengfeng Chai (Zhejiang University).

Mathieu Desbrun (Caltech).

Paweł Dłotko (Jagiellonian University, Krakow).

Leo Guibas (Stanford University).

Sun Jian (Tsinghua University, Beijing).

Leif Kobbelt (RWTH Aachen).

Sylvain Lazard (EPI VEGAS).

Michael Lesnick (Stanford University).

Jeff Phillips (University of Utah).

Alla Sheffer (University of British Columbia).

Vin de Silva (Pomona College).

Gert Vegter (Johan Bernoulli Institute, Groningen University).

Yusu Wang (Ohio State University).

7.4.2.2. Visiting Phd students

Ricard Campos (six months)

Topic: Reconstruction of 3D underwater scenes

Institution: University of Girona (Spain)

Andrea Tagliasacchi (three months)

Topic: surface reconstruction through optimal transportation

Institution: Simon Fraser University (Canada)

GRACE Team

6. Bilateral Contracts and Grants with Industry

6.1. Alcatel Lucent

In September, D. Augot and F. Levy-dit-Vehel submitted a proposal to fund a joint PhD thesis with Abdullatif Shikfa (Alcatel Lucent), on local codes for distributed storage and related cloud-like issues.

6.2. Cryptoexperts

A research agreement between Cryptoexperts and Grace has been made, to establish foundations for the DGA DIFMAT contract (see below). D. Augot is collaborating with M. Finiasz from Cryptoexperts.

LFANT Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Industrial ANR PACE

Participants: Andreas Enge, Jérôme Milan.

<https://pace.rd.francetelecom.com/>

The PACE project unites researchers of France Télécom, Gemalto, NXP, Cryptolog International, the INRIA project teams CASCADE and LFANT and University of Caen. It deals with electronic commerce and more precisely with electronic cash systems. Electronic cash refers to money exchanged electronically, with the aim of emulating paper money and its traditional properties and use cases, such as the anonymity of users during spending. The goal of PACE is to use the new and powerful tool of bilinear pairings on algebraic curves to solve remaining open problems in electronic cash, such as the strong unforgeability of money and the strong unlinkability of transactions, which would allow users to conveniently be anonymous and untraceable. It also studies some cryptographic tools that are useful in the design of e-cash systems.

7.2. DGA

Contract with *DGA maîtrise de l'information* about number theory and cryptography

- Duration: two years, 2011–2013
- Scientific coordinator: J.-M. Couveignes
- Topics covered: index calculus and discrete logarithms, fast arithmetic for polynomials, pairings and cryptography, algorithmics of the Langlands programme

7.3. Thèse cifre

Participants: Karim Belabas, Vincent Verneuil.

Vincent Verneuil, co-directed with B. Feix (Inside Contactless) and C. Clavier (Université de Limoges), works at Inside Contactless on elliptic curve cryptography, with an emphasis on embedded systems and side-channel attacks.

MARELLE Project-Team (section vide)

MEXICO Project-Team (section vide)

MUTANT Project-Team (section vide)

PAREO Project-Team (section vide)

PARKAS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- + Google European Doctoral Fellowship of Tobias Grosser. \$62000 per year over 3 years. Studying the interaction of affine loop transformations and vectorization, for multicore processors and hardware accelerators.

PARSIFAL Project-Team (section vide)

PI.R2 Project-Team (section vide)

POLSYS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Oberthur Technologies

Oberthur Technologies is the World second largest provider of security and identification solutions and services based on smart card technologies for mobile, payment, transport, digital TV and convergence markets. Since 2007, SALSA co-supervised 3 internships of first year master student on cryptology in smart-cards, and one internship of a 2nd year master student. The goal of this last internship was to study the feasibility of implementing multivariate schemes in constrained environments (typically a smart card). A new jointly supervised PhD thesis (PolSys/Oberthur) has start in march 2012.

7.2. Gemalto

Gemalto is an international IT security company providing software applications, secure personal devices such as smart cards and token, Governments, wireless operators, banks, and enterprises use Gemalto's software and personal devices to deliver mobile services, payment security, authenticated cloud access, identity and privacy protection, eHealthcare, eGovernment, transport ticketing and machine to machine (M2M) communications applications.

PolSys is currently working Gemalto – thanks to PhD grant CIFRE – on the security analysis of code-based cryptosystems (participants J.-C. Faugère, L. Perret, F. Urvoy de Portzamparc).

POP ART Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- With ST Microelectronics: CIFRE contract for the PhD of Vagelis Bebelis. This work is described in Section [6.4.1](#).

PROSECCO Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Technology Transfer Grant

Inria CSATT Technology Transfer Action for Tookan. Following successful technology transfer projects around the Tookan software with Boeing and Barclays Bank, Inria have provided 12 months of funding for a software engineer (Romain Bardou) and 10 kEuros.

S4 Project-Team (section vide)

SECRET Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Grants with Industry

- **Gemalto** (01/10 → 12/12)
CIFRE grant for Christina Boura.

SECSI Project-Team (section vide)

TASC Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Ligéro

Participants: Sophie Demassey, Xavier Lorca.

Title: **Ligéro**.

Duration: 2009-2012.

Type: Regional research group

Budget: PhD funded by the project.

Others partners: **LISA**, **IRCCyN** (team **SLP**), **LERIA** (team **MOA**), **LINA** (team **OPTI**).

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

7.2. CPER

Participant: Charles Prud'Homme.

Title: CPER.

Duration: 2010-2014.

Type: Regional research group.

Budget: 250000 Euros.

Others partners: **EMN** (team **ATLANMOD**), **EMN** (team **ASCOLA**), **IRCCyN** (team **SLP**).

Develop, promote and build up an eco-system around free software in the Pays de la Loire region. The **TASC** team is involved in the maintenance and development of the free constraint programming platform **CHOCO**.

7.3. UNIT

Participants: Nicolas Beldiceanu, Eliane Vacheret.

Title: **UNIT**.

Duration: 2011-2012.

Type: Developing teaching material.

Budget: 5000 Euros.

Others partners: **EMN** (**CAPE**).

Pedagogical material and software for learning constraints programming for non experts (integrated within the global constraint catalog).

7.4. FUI SUSTAINS

Participants: Charlotte Truchet, Bruno Belin.

Title: SUSTAINS.

Duration: 2010-2015.

Type: FUI.

Budget: 151400 Euros.

Others partners: **Artefacto**, **Artelys**, **Areva TA**, **EPAMarne**, **LIMSI**.

The **SUSTAINS** project (*Constraint-based Prototyping of Urban Environments*) aims at building decision support system for city development planning with evaluation of energy impacts. The project is focussed on spatial allocation of typical units such as industrial areas, commercial areas and leaving areas with their respective appropriate infrastructure. Its integrates sustainability, transport and energy concerns.

7.5. ANR BOOLE

Participants: Vincent Armant, Jérémie du Boisberranger, Xavier Lorca, Charlotte Truchet.

Title: **BOOLE**.

Duration: 2010-2015.

Type: open research program.

Budget: founding a PhD student and travels.

Others partners: **Univ. de Versailles Saint-Quentin**, **Univ. Caen**, **Univ. Paris 8**, **Univ. Aix-Marseille**, **Univ. Paris Nord**, **Univ. Paris 11**, **ENS Paris**.

Défi: Probabilistic method for combinatorial problems.

The work of **TASC** focuses on the use of probabilistic methods to avoid waking systematically global constraints for nothing. The goal is to provide probabilistic models for the consistency of global constraints such as *alldifferent* or *nvalue*. We compute the probability of a constraint to be still consistent after fixing one of its variables and provide an approximation that can be computed in constant time. The PhD of J. du Boisberranger is co-supervised with **D. Gardy** from **Univ. de Versailles Saint-Quentin**.

7.6. ANR NetWMS2

Participants: Nicolas Beldiceanu, Gilles Chabert.

Title: Networked Warehouse Management Systems 2: packing with complex shapes.

Duration: 2011-2014.

Type: cosinus research program, **new project**.

Budget: 189909 Euros.

Others partners: **KLS Optim** and **CONTRAINTEs** (Inria Rocquencourt).

This project builds on the former European FP6 **Net-WMS** Strep project that has shown that constraint-based optimisation techniques can considerably improve industrial practice for box packing problems, while identifying hard instances that cannot be solved optimally, especially in industrial 3D packing problems with rotations, the needs for dealing with more complex shapes (e.g. wheels, silencers) involving continuous values. This project aims at generalizing the geometric kernel *geost* for handling non-overlapping constraints for complex two and three dimensional curved shapes as well as domain specific heuristics. This will be done within the continuous solver **IBEX**, where discrete variables will be added for handling polymorphism (i.e., the fact that an object can take one shape out of a finite set of given shapes).

7.7. ANR INFRA-JVM

Participants: Xavier Lorca, Charles Prud'Homme.

Title: Towards a Java Virtual Machine for pervasive computing.

Duration: 2011-2013.

Type: **new project**.

Budget: 78000 Euros.

Others partners: Univ. Paris 6 (**REGAL** team), **LaBRI** (**LSR** team), **IRISA** (**TRISKELL**).

The **INFRA-JVM** project will investigate how to enhance the design of Java virtual machines with new functionalities to better manage resources, namely resource reservation, scheduling policies, and resource optimization at the middleware level. **TASC** is concerned with this later aspect. The performance of **CHOCO** will be improved using the memory snapshot mechanism that will be developed.

7.8. EDF

Participants: Nicolas Beldiceanu, Helmut Simonis.

Within the context of the **Gaspard Monge call program for Optimisation and Operation Research** we work with **EDF** on the research initiative on *Optimization and Energy*. The goal of the project is first to extract constraints from daily energy production temporal series issued from the 350 production plants of **EDF**, second to see how to use these constraints in order to reduce the combinatorial aspect of the daily production planning solving process. The work is based on the model seeker [19].

7.9. Google

Participants: Jean-Guillaume Fages, Xavier Lorca, Jean-Charles Régis, Louis Martin Rousseau.

Within the context of a **Google** grant involving **Jean-Charles Régis** from **Nice University**, **Louis-Martin Rousseau** from **Polytechnique Montreal** and **Xavier Lorca** and Jean-Guillaume Fages from **TASC** the following work on graph constraints has been undertaken.

In constraint programming, specific syntax for expressing unweighted circuit constraints in a graph have been proposed already since the first CP systems were developed. Most current CP systems contain a constraint to model unweighted circuits, although the associated filtering algorithm may be quite different for each system. Weighted circuit constraints are less common in CP systems, as the weights and the circuit are typically handled separately. However, several filtering algorithms have been proposed in the literature that can be applied to the weighted circuit constraint. Currently, no professional CP system offers any of these algorithms. Thus, solving problems that contain weighted circuit constraints remains a challenge for constraint programming. One of the main contributions of our work is to expand the reach of constraint programming solvers to complex routing problems. We will propose more effective filtering algorithms for the weighted circuit constraint that are guided by the resolution of real world instances and not only by benchmarking.

TOCCATA Team

7. Bilateral Contracts and Grants with Industry

7.1. Airbus contract

Participant: Sylvain Conchon [contact].

This 2 years support contract has started in Sep 10, between Inria and Airbus France at Toulouse. This is to support our efforts for the DO-178B qualification of Alt-Ergo.

7.2. CIFRE contract with Adacore

Participants: Claude Marché [contact], Andrei Paskevich, Claire Dross.

Jointly with the thesis of C. Dross, supervised in collaboration with the Adacore company, we established a bilateral collaboration contract, that started in January 2012 for 3 years.

The aim is to strengthen the usability of the *Alt-Ergo* theorem prover in the context of the GnatProve environment for the verification of safety-critical Ada programs [32]. A focus is made on programs involving Ada containers [80].

TRIO Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Ph.D. thesis under CIFRE collaboration with PSA

Participants: Aurélien Monot, Nicolas Navet, Françoise Simonot-Lion

The complexity of electronic embedded systems in cars is continuously growing. Hence, mastering the temporal behavior of such systems is paramount in order to ensure the safety and comfort of the passengers. As a consequence, the verification of end-to-end real-time constraints is a major challenge during the design phase of a car. The AUTOSAR software architecture drives us to address the verification of end-to-end real-time constraints as two independent scheduling problems respectively for electronic control units and communication buses.

First, we introduce an approach, which optimizes the utilization of controllers scheduling numerous software components that is compatible with the upcoming multicore architectures. We describe fast and efficient algorithms in order to balance the periodic load over time on multicore controllers by adapting and improving an existing approach used for the CAN networks. We provide theoretical result on the efficiency of the algorithms in some specific cases. Moreover, we describe how to use these algorithms in conjunction with other tasks scheduled on the controller [12], [8].

The remaining part of this research work addresses the problem of obtaining the response time distributions of the messages sent on a CAN network. First, we present a simulation approach based on the modelisation of clock drifts on the communicating nodes connected on the CAN network. We show that we obtain similar results with a single simulation using our approach in comparison with the legacy approach consisting in numerous short simulation runs without clock drifts. Then, we present an analytical approach in order to compute the response time distributions of the CAN frames. We introduce several approximation parameters to cope with the very high computational complexity of this approach while limiting the loss of accuracy. Finally, we compare experimentally the simulation and analytical approaches in order to discuss the relative advantages of each of the two approaches [20], [8].

TYPICAL Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Common Research Agreements in the MSR–Inria Joint Centre

Assia Mahboubi, Enrico Tassi and Cyril Cohen are part of the *Mathematical Components* effort in the Inria and Microsoft Research joint centre. The goal is to investigate the design of large-scale, modular and reusable libraries of formalized mathematics. Developed using the Coq proof assistant. This project successfully formalized the proof of the Feit–Thompson theorem, resulting in a corpus of libraries related to various areas of algebra.

Project *Coquelicot*, funded jointly by the Fondation de Coopération Scientifique “Campus Paris-Saclay” and Digiteo.

Goal: Create a new Coq library for real numbers of mathematics.

Leader: S. Boldo (INRIA Saclay, Toccata). Participant: A. Mahboubi.

Website: <http://coquelicot.saclay.inria.fr/>.

VEGAS Project-Team (section vide)

VERIDIS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Tools and Methodologies for Formal Specifications and for Proofs

Participants: Stephan Merz, Hernán-Pablo Vanzetto.

We participate in the project on **Tools and Methodologies for Formal Specifications and for Proofs** at the MSR-Inria Joint Centre. The objective of the project is to develop a proof environment for verifying distributed algorithms in TLA⁺ (see also sections **5.2** and **6.1**). In particular, the project funds the PhD thesis of Hernán Vanzetto.

VERTECS Project-Team (section vide)

ALEA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Contract with CEA CESTA. The aim of this contract is to develop several extensions to the software BiiPS and to provide a Bayesian statistical modelling on various problems of interest to CEA.

Contract with Astrium/EADS. The aim of this contract, in collaboration with the EPI AYIN, is to develop automatic object tracking algorithms on a sequence of images taken from a geostationary satellite. P. Del Moral cosupervises with J. Zerubia the PhD thesis of Paula Craciun on this subject.

Contract with Dassault. The aim of this contract, in collaboration with the EPI I4S is to address calibration problems using interacting Kalman filters.

APICS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contract CNES-Inria-Xlim

Contract (reference Inria: 7066, CNES: 127 197/00) involving CNES, XLim and Inria, focuses on the development of synthesis procedures for N -ports microwave devices. The objective is here to derive analytical procedures for the design of multiplexers and routers as opposed to the classical "black box optimization" which is usually employed in this field (for $N \geq 3$).

7.2. Contract CNES-Inria-UPV/EHU

Contract (reference CNES: RS10/TG-0001-019) involving CNES, University of Bilbao (UPV/EHU) and Inria whose objective is to set up a methodology for testing the stability of amplifying devices. The work at Inria concerns the design of frequency optimization techniques to identify the linearized response and analyze the linear periodic components.

ASPI Project-Team (section vide)

BACCHUS Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

The research department of Volkswagen AG uses the OpenFOAM fluid dynamics code, among other software. The parallel version of this code relies on Scotch to distribute mesh data across processors. When running their simulations, the engineers of VW in charge of running numerical simulations have noticed load imbalance among the processors, and would like to have this problem solved in order to achieve better machine utilization.

The purpose of this contract is to investigate the potential causes of the evidenced imbalance, and to find remedies to it. The proposed solutions should be integrated in the trunks of Scotch and/or of OpenFOAM. This contract started in April and ended in December.

BIPOP Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. CIFRE THESIS

7.1.1. *Schneider Electric*

Participants: Vincent Acary, Narendra Akadkhar, Bernard Brogliato.

This is a long-term relationship with this company, starting in 2001 with the post-doc of V. Acary. A PhD thesis funded by SE started in December 2012 (Narendra Akadkhar), co-supervised by V. Acary and B. Brogliato, and by M. Abadie (SE). The topic is about simulation of circuit breakers with mechanical play, and multiple impacts with friction modelling.

7.1.2. *ANSYS*

Participants: Vincent Acary, Mounia Haddouni, Bernard Brogliato.

This collaboration started in May 2012 with the CIFRE thesis of M. Haddouni. The topic is about numerical simulation of multibody systems with unilateral contact, impacts and friction.

7.1.3. *ALDEBARAN*

Participants: Pierre-Brice Wieber, Jory Lafaye.

This collaboration started in March 2012 with the CIFRE thesis of J. Lafaye. The topic is biped walking control schemes in dynamic environments.

7.1.4. *ADEPT*

Participants: Pierre-Brice Wieber, Saed Al Homsy.

This collaboration started in September 2012 with the CIFRE thesis of S. Al Homsy. The topic is fast reactive motion generation for manipulator robots.

7.2. Other contracts

7.2.1. *L'OREAL*

Participant: Florence Bertails-Descoubes.

L'OREAL: Contrat d'étude with L'Oréal, starting in December 2012 until April 2013 .

CAD Team

7. Bilateral Contracts and Grants with Industry

7.1. EADS

We cooperate with EADS on geometric representation and FEM.

7.2. CAS-BEGCL Imaging Technology Corporation

We cooperate with CAS-BEGCL Imaging Technology Corporation on fluid simulation, object deformation and realistic rendering.

7.3. ANR/ NSFC AND SYSTEM@TIC: 2010-2013

The objectives of these Programs address Geometry Modeling and Computing, mainly Robustness and Tolerance as well as Geometric Uncertainties.

CAGIRE Team (section vide)

CALVI Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

We have started a collaboration with the SME (Small and Medium Enterprise) AxesSim on the development of Maxwell solvers. AxesSim is specialized on scientific software for airplane electromagnetic compatibility. For the moment, one CIFRE thesis is supported by DGA. Gary Cohen from Inria Rocquencourt is also involved in the project.

CASTOR Team (section vide)

CLASSIC Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Students Paid by Industrial Partners / Contracts with Industry

- Gérard Biau finished supervising the PhD thesis of Benoît Patra, which took place till March 2012 within an industrial contract (“thèse CIFRE”) with Lokad.com (<http://www.lokad.com/>).
- Gérard Biau has been supervising the PhD thesis of Baptiste Gregorutti since December 2011, within an industrial contract (“thèse CIFRE”) with Safety Line (<http://www.safety-line.fr/index.php/fr/>)
- Gilles Stoltz has been supervising the PhD thesis of Pierre Gaillard, which takes place since September 2012 within an industrial contract (“thèse CIFRE”) with EDF R&D (<http://innovation.edf.com/>).
- Gilles Stoltz supervised the M.Sc. internship of Charles-Pierre Astolfi, which took place within a collaboration with IFP Energies nouvelles (<http://www.ifpenergiesnouvelles.fr/>).

COFFEE Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

- ANDRA

In 2011/12, S. Krell and T. Goudon, with A. Gloria, have worked on the development of homogenization methods for the simulation of the transport of radionuclides in porous media. A new numerical method has been proposed, based on Reduced Basis techniques which allows efficient computation of the (space-dependent) effective coefficients. In 2012/13 we start a new collaboration devoted to the modeling and simulation of ventilation devices in nuclear waste disposal. This is a long-term project (with the PhD of Y. Zhang) which aims at solving numerically systems of PDEs describing mass and heat transfer between porous media and ventilation channels. Generally speaking ANDRA has strong needs of numerical tools for simulating transient water/gas flows (with typical applications to understand gas flows emanating from corroded confining devices in nuclear waste disposal and mass/heat exchanges in circulation channels). The performances and flexibility of the commercial code Tough2 are definitely too restricted. It is likely that fostering the skills of several Inria teams working on these topics can be decisive to design new two-phase codes using modern schemes and complex meshes, with domain decomposition methods and parallel procedures.

- CEA

We work on the simulation of two-phase flows described by Eulerian/Lagrangian models. To this end, A. Champmartin develops a new semi-Lagrangian algorithm for fluid-kinetic coupling, in collaboration with CEA/DAM and the LRC Manon.

- GDFSuez EP-Storengy - (Contract with UNS-CNRS)

The collaboration is devoted to the control of rock permeability by polymer injections, and to the simulation of flows in tight rocks, with weak permeabilities. These questions lead to consider highly heterogeneous and fractured media; in turn simulations should use highly unstructured meshes. During her post-doc, C. Guichard develops new methods for diphasic flows in porous media, with application to tight gas and gas stockage.

- TOTAL (Contract with UNS-CNRS)

R. Masson is scientific consultant of the recently created team “Nouveau Simulateur de Réservoir”, led by B. Faissat. The team is concerned with the development of new research codes for oil recovery problems, based on FV methods. Through the post doc of W. Kherriji, we develop new domain decomposition algorithm for the simulation of oil recovery, with local refinement, both in time and space. C. Guichard works on Finite Volumes methods on unstructured meshes.

COMMANDS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Renault

Participants: Frédéric Bonnans, Giovanni Granato, Hasnaa Zidani.

This contract has supported the PhD thesis of Giovanni Granato. The purpose of this collaboration is to apply optimal control techniques to enhance the performance of the power management of hybrid vehicles. More precisely, the techniques concerned are viscosity solutions of Hamilton-Jacobi (HJ) equations, level set methods in reachability analysis, stochastic dynamic programming (SDP), stochastic dual dynamic programming (SDDP) and chance constrained optimal control. These are relatively sophisticated optimal control techniques, presenting a rupture (from the application point of view) of more classical techniques (e.g. dynamic programming, maximum principle and heuristic algorithms) found in the literature. The outcome of the PhD work is to assess the general interest in applying such techniques to the power management of hybrid vehicles. This includes stating the relevant modeling choices, implementing a research-level code of the algorithms for simulations and providing a proper interpretation of the simulations results.

The research undertaken in this contract have lead to four submitted patents (Renault-Inria), a numerical platform for simulations of the studied technics, 1 accepted conference paper (CDC), 2 submitted papers in peer-reviewed journals, and 2 preprints in preparation.

7.2. Astrium-Eads

Participant: Hasnaa Zidani.

This collaboration aims at analysing the sensitivity properties of a trajectory optimisation problem under probabilistic constraints (on modelling errors, component failure, ...etc). This includes a modeling of the problem, and implementation of efficient algorithms supporting the theoretical study. The collaboration started in 2012 and will last three years.

CONCHA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Optimal (Aerospace Valley)

Participants: Roland Becker, Kossivi Gokpi, Robert Luce, Eric Schall, David Trujillo.

Optimal is a research project related to the cooling of the stator of a turbomachinery. Both physical experiments and numerical simulations are employed. This project has three industrial (Liebherr, Epsilon, and SIBI) and three academic partners (Universities of Pau, Poitiers, and Toulouse). It has been evaluated by the cluster Aerospace Valley. The PhD-thesis of Kossivi Gokpi is financed by this project.

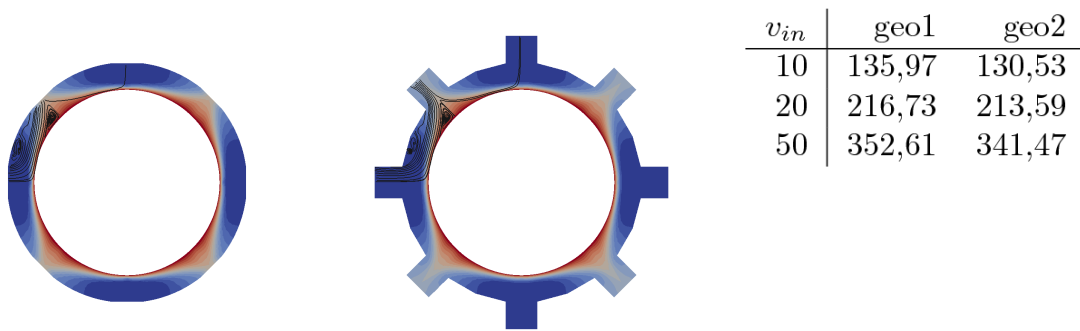


Figure 15. Temperature field and recirculation for two geometries and computed Nusselt numbers for different inflow velocities.

Our contributions concern the numerical simulation of the viscous flow in different geometrical configurations. Comparison with experimental data will be investigated with respect to the Nusselt number. The computed temperature and streamlines for typical geometries are shown in Figure 15. In addition, the computed Nusselt numbers for the two configurations and varying inflow velocities are given.

Among the different questions concerning modeling such as the boundary conditions at the in- and outlets and the sensitivity to the geometry, a particular point of interest is the study of compressibility effects.

The experimental part of the product is conducted in collaboration with Mathieu Mory, professor at UPPA, and the post-doctoral position of Stéphane Soubacq, who started to work in 10/2009, is financed by the project. The modeling and numerical simulation is done in collaboration with Abdellah Saboni, professor at UPPA.

7.2. Fractured reservoir (Total)

Participants: Robert Luce, David Trujillo.

We have developed specific meshing tools in order to take into account the interaction between faults and a petroleum reservoir for the company Total. This work was done in collaboration with Eric Dubach and Pierre Puisieux from LMA.

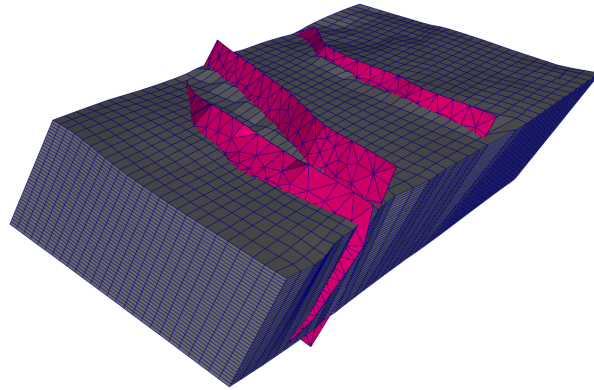


Figure 16. Fractured reservoir

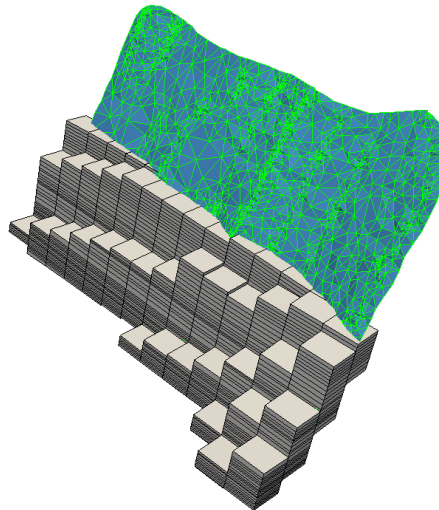


Figure 17. Intersection between fault and reservoir

CORIDA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. FRAE (Fondation de Recherche pour l'Aéronautique et l'Espace)

In March 2010, Karim Ramdani obtained a 2 years funding from FRAE³ to work on inverse problems in Aeronautics. The project involves two partners : Inria Nancy Grand-Est (7 participants, from which 5 members of CORIDA) and ONERA Toulouse (4 participants).

7.2. EADS Foundation

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

³Fondation de Recherche pour l'Aéronautique et l'Espace : <http://www.fnrae.org/>

CQFD Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Astrium

Participants: Romain Azaïs, Adrien Brandejsky, Benoîte de Saporta, François Dufour, Anne Gégout-Petit, Huilong Zhang.

The goal of this project is to propose models for fatigue of structure and to study an approach to evaluate the probability of occurrence of events defined by the crossing of a threshold. In this context, Astrium funded the PhD Thesis of Adrien Brandejsky (2009-2012) and is a partner of ANR Fautocoos.

6.2. DCNS

Participants: Benoîte de Saporta, François Dufour, Huilong Zhang.

In september 2010, an industrial collaboration started with DCNS on the application of Markov Decision Processes to optimal stochastic control of a submarine to maximize the acoustic signature of a target vessel. In 2012, we extended our previous results to multiple target vessels and 3D control. We also coupled our code with the output of a tracking software to take more realistically into account the uncertainty on the position and speed of the targets. This work gave rise to a new technical report [54] and a presentation in an international conference [35].

6.3. EDF Approdyn

Participants: Benoîte de Saporta, François Dufour, Huilong Zhang.

The objective of this project is develop new methodologies for studying the dynamic reliability of controlled systems used in the critical area of power generation and process industries. We work on a benchmark of steam generator with four physical processes: feedwater flowrate , steam flow, narrow range water level and wide range water level. A PID controller is used to maintain the water level within limits of set-points. The system is composed of seven components: 1 passive system representing vapor transport system, 3 extraction pumps, 2 feeding turbopumps, and 1 waterflow regulation valve. We also take into account captors and their possible failures. This work gave rise to a technical report [53] and was presented in an international conference [36], a national conference [39] and is published as a book chapter [49].

6.4. Thales Optronique

Participants: Camille Baysse, Benoîte de Saporta, François Dufour, Anne Gégout-Petit, Jérôme Saracco.

Integrated maintenance, failure intensity, optimisation.

The goal of the project is the optimization of the maintenance of a on board system with a HUMS (Health Unit Monitoring Systems). The collaboration is the subject of the PhD of Camille Baysse (CIFRE) on this problem. This work gave rise to a technical report, was presented in an international conference [30], a national conference [38] and is submitted for publication

6.5. LyRE

Participant: Jérôme Saracco.

The goal of this contract with the LyRE (R & D research center of Lyonnaise des Eaux) is to provide management and consultancy tools to keep the immense heritage of these drinking water and sanitation distribution networks in optimal condition. A PhD student (K. Claudio) of J. Saracco is working in the LyRE team on sampling problems coming from a partial automatic teletransmission of water consumption data. This works has been presented at the “7ème colloque francophone sur les sondages” on November 2012 at ENSAI, Rennes. The lecture is untitled “Estimation de la consommation d’eau d’un secteur à partir d’un échantillon d’usagers télérelevés”.

A patent describing the statistical methodology has also been registered in November 2012.

DEFI Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Grègoire Allaire is in charge of the RODIN project. This is a consortium of various companies and universities which has been sponsored by the FUI AAP 13 for 3 years, starting on July 2012. The industrial partners are: Renault, EADS, ESI, Eurodecision, Alneos, DPS. The academic partners are: CMAP at Ecole Polytechnique, Laboratoire J.-L. Lions at Paris 6 and 7 Universities, centre de recherches Bordeaux Su-Ouest at Inria. The goal of the RODIN project is to perform research and develop a computer code on geometry and topology optimization of solid structures, based on the level set method. RODIN is the acronym of "Robust structural Optimization for Design in INdustry".
- Grègoire Allaire has a contract with IFPEN on multiscale finite elements for two-phase flows in porous media (in the framework of the PhD thesis of F. Ouaki, to be defended in 2013).
- Grègoire Allaire has a contract with EADS/IW on topology optimization for composite panels drapping (in the framework of the PhD thesis of G. Delgado, to be defended in 2013).
- Grègoire Allaire has a contract with Renault on geometry and topology optimization of structures (in the framework of the two PhD theses of Ch. Dapogny, with the co-advising of P. Frey, to be defended in 2013, and G. Michailidis, with the co-advising of F. Jouve, to be defended in 2013).
- Houssein Haddar is in charge of DEFI part of the FUI project Nanolytix. This three years project started in October 2012 and involves Xenocs (coordinator), imXPAD, Arkema, Inria (DEFI) and CEA-Leti. It aims at building a compact and easy-to use device that images nonparticles using X-ray diffraction at small or wide angles (SAXS and WAXS technologies). We are in charge of direct and inverse simulation of the SAXS and WAXS experiments.
- Houssein Haddar is in charge of the electromagnetic simulation work package of the FUI project Tandem. This three years project started in December 2012 and involves Bull-Amesys (coordinator), BOWEN (ERTE+SART), Ecole Polytechnique (CMAP), Inria, LEAT et VSM. It aims at constructing a radar system on a flying device capable of real-time imaging mines embedded in dry soils (up to 40 cm deep). We are in charge of numerical validation of the inverse simulator.
- Houssein Haddar has a contract with EDF R&D on non destructive testing of concrete materials (in the framework of the PhD thesis of Lorenzo Audibert, to be defended in 2015)
- Houssein Haddar has a contract with EDF R&D on data assimilation for temprature estimates in nuclear reactors (in the framework of the PhD thesis of Thibault Mercier, to be defended in 2015)
- Houssein Haddar is coordinating the contract EDF R&D on non eddy current non destructive testing. This contract involves Zixian Jiang (PhD to be defended in 2013) and a two years PostDoc, Kamel Riahi.

7.2. Bilateral Grants with Industry

- Grègoire Allaire is a scientific adviser at the DM2S department of CEA Saclay.

DISCO Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

As a part of his research actions in the Control Department of Supélec, Guillaume Sandou has numerous collaborations with Industry (Renault, Astrium, Sagem, Valeo). This may lead to relevant opportunities for the DISCO project.

Guillaume Sandou is in particular the head of the RISEGrid Institute (Research Institut for Smarter Electric Grids), joint institute between Supelec and EDF R&D.

DOLPHIN Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- EDF (2011-2013): Bilevel mathematical programming and pricing problems.
- EDF (2011-2014): Scheduling outages of nuclear plants.
- Tasker (2011-2014) : Scheduling of applications in hybrid cloud computing systems.
- Alicante (2010-2013): PhD of Julie Jacques. Knowledge extraction by optimization methods for improving the process of inclusion in clinical trials.
- Genes Diffusion (2010-2013): PhD of Julie Hamon. Analysis of data from high throughput genotyping: cooperation between statistics and combinatorial optimization.
- Strat&Logic (2012-2015): PhD of Sylvain Dufourny. Optimization of economic decisions in a competitive business management simulator.
- Vekia (2012-2015). The goal of the project is to develop an efficient and generic software for employee scheduling in retail.
- BTravel (2011-2015). This project deals with the optimization of group travel plannings.
- NewCo (2011-2012) : Optimisation of client programs in the tourism industry.

GAMMA3 Project-Team

4. Bilateral Contracts and Grants with Industry

4.1. Bilateral Contracts with Industry

- ANDRA, partenariat stratégique, projet 2, *Maillage adaptatif hexaédrique du milieu géologique multicouche avec prise en compte des ouvrages de stockage et des évolutions géodynamiques*, P. Laug et H. Borouchaki, 48 k-euros, 12/07/2011 - 12/09/2012.
- DASSAULT, *Maillage surfacique et topologie*, P. Laug et H. Borouchaki, 33 k-euros, 01/01/2010 - 31/12/2012.
- LECTRA, *Redéfinition des domaines de paramètres*, P. Laug et H. Borouchaki, 6 k-euros, 20/09/2011 - 19/09/2012.

4.2. Bilateral Grants with Industry

- Fondation EADS Grant, F. Alauzet, 150 k-euros, 2012-2015
- Fondation EADS Grant, A. Loseille, 140 k-euros, 2012-2015

GECO Team (section vide)

GEOSTAT Project-Team (section vide)

I4S Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. *Contracts with SVS*

Participants: Laurent Mevel, Michael Döhler.

Annual agreement Inria-SVS 2381 + contract 4329

I4S is doing technology transfer towards SVS to implement I4S technologies into ARTEMIS Extractor Pro. This is done under a royalty agreement between Inria and SVS .

7.2. Bilateral Grants with Industry

7.2.1. *PhD CIFRE with Dassault Aviation*

Participants: Laurent Mevel, Philippe Mellinger.

Following the FLiTE2 project, a joint PhD thesis between Inria and Dassault Aviation has been initiated. The thesis will pursue the work achieved in FLiTE2 and started in June 2011 funded by Dassault Aviation and the CIFRE Agency.

IPSO Project-Team (section vide)

MATHRISK Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

PREMIA consortium, presently composed of Crédit Agricole CIB, Société Générale, Natixis, and Pricing Partners.

MAXPLUS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contrats avec l'Industrie/Bilateral Contracts with Industry

- Optimisation de services en ligne: CRE avec Orange Labs (responsable du suivi Orange Labs: Mustapha Bouhtou), de février 2009 à février 2012, portant sur l'application de l'optimisation à la tarification et à l'amélioration de services en ligne. Ce travail applique des techniques d'optimisation (processus de décision markoviens) et d'analyse non-linéaire (généralisations d'algorithmes de classement de type "pagerank") dans un but notamment d'amélioration du référencement, et étudie les problèmes de tarification reliés. Ce contrat a financé la thèse d'Olivier Fercoq, soutenue en Septembre 2012.
- Thèse CIFRE de J-B. Dumont, financée par Orange Labs (encadrant Orange Labs: Mustapha Bouhtou, directeur de thèse: S. Gaubert), démarrée en septembre 2010. Sujet: tarification de services data et gestion des ressources dans les réseaux mobiles 3G et LTE.

MC2 Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Program PREDIT

Participants: Charles-Henri Bruneau, Iraj Mortazavi.

Program PREDIT ADEME with Renault and Peugeot. The aim of this program is the work on drag reduction in order to decrease the fuel consumption.

7.2. Renault

Participants: Charles-Henri Bruneau, Iraj Mortazavi.

CARAVAJE project with ADEME (PREDIT Véhicules propres et économes) notified october 24th 2008. Collaboration with Renault and Peugeot, two PME and 3 labs to reduce the drag coefficient of a ground vehicle. 95 k euros for 3 years.

7.3. Plastic Omnium

Participant: Iraj Mortazavi.

The MC2 team works actually with the Plastic Omnium company in order to study the flow behaviour around square back ground vehicles (like buses, camions,...) using LES and DNS techniques. The main target of this collaboration is to identify the structures of velocity fields that generate aerodynamical losses, in order to design drag reduction control strategies using pulsed or synthetic jets. In the framework of this project, we also want to compute accurately instantaneous velocity fields, with high velocities. The computations should be performed on long time for complex geometries. A part of this work is included in the PhD thesis of Yoann Eulalie.

7.4. Contracts with Industry

Thierry Colin is Scientific consulting for the CEA CESTA. The CEA is funding the thesis of M. Latige and a grand of 30 k euros has been obtained.

Angelo Iollo is consulting with OPTIMAD engineering.

7.5. Grants with Industry

CIFRE - Conventions Industrielles de Formation par la REcherche - with VALEOL (VALOREM Group)

MCTAO Team

6. Bilateral Contracts and Grants with Industry

6.1. Thales Alenia Space - Inria

“Transfert orbital dans le problème des deux et trois corps avec la technique de propulsion faible”.

This contract starts October, 2012 for 3 years. It partially supports Helen Heninger’s PhD.

The goal is to improve transfer strategies for guidance of a spacecraft in the gravitation field of one central body (the two-body problem) or two celestial bodies (three-body problem).

6.2. CNES - Inria - UPV/EHU

Contract (reference CNES: RS10/TG-0001-019) ending May, 2013. It involves CNES, University of Bilbao (UPV/EHU) and Inria; its objective is to set up a methodology for testing the stability of nonlinear amplifying devices via frequency optimization techniques.

On the Inria side, this contract concerns McTAO for 25% and APICS project-team for 75%.

MICMAC Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Contracts and Grants with Industry

Many research activities of the project-team are conducted in close collaboration with private or public companies. The project-team is also supported by Office of Naval Research and European Office of Aerospace Research and Development, for multiscale simulations of random materials. All these contracts are operated at and administrated by the Ecole des Ponts.

MISTIS Project-Team (section vide)

MODAL Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Arcelor-Mittal

Participants: Christophe Biernacki, Clément Thery.

Subject : *Supervised and semi-supervised classification on large data bases mixing qualitative and quantitative variables.*

Arcelor Mittal faced some quality problems in the steel production which lead to supervised and semi-supervised classification involving (1) a small number of individuals comparing to the numbers of variables, (2) heterogeneous variables, typically categorical and continuous variables and (3) potentially highly correlated variables. A PhD CIFRE grant started on May 2011 on this topic.

7.2. Gene Diffusion

Participants: Julien Jacques, Julie Hamon.

Subject : *Data analysis from high throughput technologies: Synergy between statistics and combinatorial optimization.*

With the development of new technologies such as high-throughput genotyping and sequencing, data analysis needs to be improved. Genes Diffusion is specialized in animals studies, for which we can read genomics information on around 800 000 markers and we have more and more subjects. The aim of the PhD is to find new methods combining combinatorial optimization and statistics methods in order to characterize the best subjects according to quantitative criteria. A PhD CIFRE grant started on 2010 and it is a joined work with Clarisse Dhaenens (Inria/DOLPHIN).

7.3. ASEL & CRESGE

Participants: Cristian Preda, Michael Genin.

Subject : *Incidence of lymphomas in Nord-Pas-de-Calais, Annual Estimates and study of the evolution over the period 2001-2005.* It is a contract with ASEL (Association Septentrionale pour l'Étude de Lymphomes) and CRESGE (Centre de Recherches Economiques Sociologiques et de Gestion) from Lille. This project of 6000 euros started on September 1st 2012 and ends on Mai 1st 2013.

NACHOS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. High order DGTD- \mathbb{P}_p Maxwell solver for numerical dosimetry studies

Participants: Stéphane Lanteri, Joe Wiart [WHIST Laboratory, Orange Labs, Issy-les-Moulineaux].

The objective of this research grant with the WHIST (Wave Human Interactions and Telecommunications) Laboratory at Orange Labs in Issy-les-Moulineaux is the adaptation of a high order DGTD- \mathbb{P}_p method on tetrahedral meshes developed in the team and its application to numerical dosimetry studies in the context of human exposure to electromagnetic waves emitted from wireless systems. These studies involve realistic geometrical models of human tissues built from medical images.

7.2. Seismic risk assessment by a discontinuous Galerkin method

Participants: Nathalie Glinsky, Stéphane Lanteri, Fabien Peyrusse.

The objective of this research grant with IFSTTAR <http://www.ifsttar.fr> (French institute of sciences and technology for transport, development and networks) and CETE Méditerranée is the numerical modeling of earthquake dynamics taking into account realistic physical models of geological media relevant to this context. In particular, a discontinuous Galerkin method will be designed for the solution of the elastodynamic equations coupled to an appropriate model of physical attenuation of the wave fields for the characterization of a viscoelastic material.

7.3. High order DGTD- \mathbb{P}_p Maxwell solver for electric vulnerability studies

Participants: Loula Fezoui, Stéphane Lanteri, Muriel Sesques [CEA/CESTA, Bordeaux].

The objective of this research grant with CEA/CESTA in Bordeaux is the development of a coupled Vlasov-Maxwell solver combining the high order DGTD- \mathbb{P}_p method on tetrahedral meshes developed in the team and a Particle-In-Cell method. The resulting DGTD- \mathbb{P}_p /PIC solver is used for electrical vulnerability assessment of the experimental chamber of the *Laser Mégajoule* system.

NANO-D Team (section vide)

NECS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. *KARRUS start-up*

The NeCS team is continuing its activity in road traffic modeling and control. The expected scientific contribution of NeCS in this field concerns the development of new estimation prediction and identification algorithms based on the measurements collected through sensor networks installed on freeways. The team study also the problems of time-to destination and control algorithms for ramp metering. The team is currently setting up a consortium with local authorities involved in traffic management to build a demonstrator called GTL for Grenoble Traffic Lab. One target of this activity is to transfer part of the developed technology to a start-up named Karrus and led by Denis Jacquet (<http://www.karrus.fr/>). The start-up was created in January 2010.

7.2. Bilateral Grants with Industry

7.2.1. *AIRBUS*

Accompanying PhD contract with AIRBUS in the framework of the CIFRE PhD grant of P. Andrianiaina. The goal of this PhD thesis is to study flexible implementation methods for real-time controllers, aimed at reducing the conservatism induced by the current approach purely based on worst case considerations.

7.2.2. *IFPEN*

Accompanying PhD contract with IFPEN (IFP Energies Nouvelles), in the framework of the PhD grant of A. Ben Khaled. The thesis explores new architectures and flexible scheduling methods to enhance the trade-off between the integration accuracy and the simulation speed of distributed real-time (hardware-in-the-loop) simulators, in particular in the framework of automotive power-trains.

Accompanying PhD contract with IFPEN (IFP Energies Nouvelles), in the framework of the PhD grant of Giovanni de Nunzio. The thesis explores eco-driving for communicating vehicles in urban environment.

NON-A Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Projects

- Project SYSIASS <http://www.sysiass.eu/>;
 - Subject: Autonomous and Intelligent Healthcare System;
 - Partners: ISEN de Lille, Ecole Centrale de Lille, University of Kent, University of Essex, East Kent Hospitals University NHS Foundation Trust, Groupement Hospitalier de l'Institut Catholique de Lille;
 - Duration: 2010 - 2013;
 - Support: FEDER;
- Project CHASLIM <http://chaslim.gforge.inria.fr/>;
 - Subject: Sliding mode control;
 - Partners: Inria Grenoble-Rhône Alpes, Inria Lille-Nord Europe, Ecole Centrale de Nantes;
 - Duration: 2011-2014;
 - Support: ANR;
- Project HYCON2 <http://www.hycon2.eu/>;
 - Subject: Networked control systems;
 - Partners: See <http://www.hycon2.eu/?page=5&PHPSESSID=c185e278a6cab0a35c8dea0970c5723d>
 - Duration: 2010-2015;
 - Support: FP7;
- Project SENSAS <http://sensas.gforge.inria.fr/wiki/doku.php>;
 - Subject: Sensor network Applications;
 - Partners: Inria Grenoble-Rhône Alpes, Inria Lille-Nord Europe, Inria Sophia Antipolis-Méditerranée, Inria Nancy-Grand Est;
 - Duration: 2010-2014;
 - Support: ANR;
- Project SLIM
 - Subject: Software library for multi-robots cooperation;
 - Duration: 2012-2014;
 - Support: Inria ADT;
- Project FP7 ERRICS <http://cordis.europa.eu/projects/index.cfm?fuseaction=app.details&TXT=ERRIC&FRM=1&STP=10>
 - Subject: ERRIC-Empowering Romanian Research on Intelligent Information Technologies;
 - Partners: UNIVERSITATEA POLITEHNICA DIN BUCURESTI;
 - Duration: 2010-2013;
 - Support: EU FP7 Capacities Programme.

OPALE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

ArcelorMittal-Inria industrial contract n. 5013 : Opale started a thorough collaboration in optimal design of high performance steel with the mentioned world leader industrial. The aim of the collaboration is to develop and study new and efficient tools dedicated to multicriteria shape optimization of structures which undergo large non-linear elasto-plastic deformations.

The present contract has three years duration and funds the Ph.D. thesis of Aalae Benki and Research financial support.

POEMS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contract POEMS-CEA-LIST-2

Participant: Anne-Sophie Bonnet-Ben Dhia.

Start : 09/01/2010, End : 07/31/2013. Administrator : ENSTA.

This contract is about the scattering of elastic waves by a stiffener in an anisotropic plate.

7.2. Contract POEMS-CEA-LIST-3

Participants: Laurent Bourgeois, Eric Lunéville.

Start : 10/01/2011, End : 09/30/2012. Administrator : ENSTA.

This contract is about the linear sampling methods for elastic waveguides.

7.3. Contract POEMS-CEA-LIST-DIGITEO

Participants: Anne-Sophie Bonnet-Ben Dhia, Sonia Fliss, Antoine Tonnoir.

Start : 10/01/2011, End : 09/30/2014. Administrator : ENSTA.

This contract is about the scattering of elastic waves by a local defects in an anisotropic plate. It consists on the funding of Antoine Tonnoir's Phd.

7.4. Contract POEMS-DGA

Participants: Anne-Sophie Bonnet-Ben Dhia, Bérangère Delourme, Sonia Fliss, Patrick Joly.

Start : 09/01/2011, End : 12/31/2013. Administrator : ENSTA.

This contract is about the waveguide in photonic crystals : we want to develop new mathematical and numerical tools for the characterization, the study and the computation of the guided modes in photonic crystals.

REALOPT Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contract with EDF on maintenance planning

We are currently working on a project aiming to plan the energy production and the maintenance breaks for a set of nuclear power plants generating electricity. This problem has two different levels of decisions. The first one consist in determining, for a certain time horizon, when the different power plants will have to stop in order to perform maintenance and to decide the amount of fuel to be reloaded. The second decision level aims to decide the quantity of power each plant will have to produce for each probabilistic scenario on the energy consumption and the duration of maintenance. The model that we are considering combines issues of stochastic optimization (to handle demand scenarios), robust optimization (to account for variation in maintenance duration), and dynamic optimization (the maintenance of nuclear plants are programmed on a five year horizon, but the long term planning is review each month for adjustments due to perturbations).

This project is carried in collaboration between EDF R&D (OSIRIS lab) Inria team Dolphin and Realopt. The research is the subject of the PhD thesis of Nicolas Dupin (DGA).

REGULARITY Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

CSDL (Complex Systems Design Lab) project of the Pôle de Compétitivité SYSTEM@TIC PARIS-REGION (11/2009-10/2012). The goal of the project is the development of a scientific platform of decisional visualization for preliminary design of complex system. Industrial partners include Dassault Aviation, EADS, EDF, MBDA and Renault. Academic partners include ECP, Ecole des Mines de Paris, ENS Cachan, Inria and Supelec.

SCIPORT Team (section vide)

SELECT Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contracts with EDF

Participants: Gilles Celeux, Jean-Michel Poggi.

- SELECT has a contract with EDF regarding modelling uncertainty in deterministic models.
- SELECT has a contract with EDF regarding wavelet analysis of the electrical load consumption for the aggregation and disaggregation of curves to improve total signal prediction.

7.2. Other contracts

Participants: Gilles Celeux, Rémy Fouchereau, Patrick Pamphile.

- SELECT has a contract with SAFRAN - SNECMA, an high-technology group (Aerospace propulsion, Aircraft equipment, Defense Security, Communications), regarding modelling reliability of Aircraft Equipment (collaboration with Patrick Pamphile (Université Paris-Sud)).

SEQUEL Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Orange Labs

Participant: Jérémie Mary.

There has been various activities between SEQUEL and Orange Labs.

First, the collaboration around the PhD of Christophe Salperwyck has continued and eventually led to his defense. Second, a CRE has been signed in 2011 to continue our work on web advertising, and more generally, collaborative filtering. On this topic, Sami Naamane has been hired in Fall 2011 as PhD student.

7.2. Effigie

Participant: Jérémie Mary.

We are currently working on better prediction of news websites audiences in order to plan some better strategies for marketing services. A prediction module should be produced in 2013.

7.3. Squoring Technology

Participants: Boris Baldassari, Philippe Preux.

Boris Baldassari has been hired by Squoring Technology (Toulouse) as a PhD student in May 2011. He works on the use of machine learning to improve the quality of the software development process. During his first year as a PhD student, Boris investigated the existing norms and measures of quality of software development process. He also dedicated some times to gather some relevant datasets, which are made of either the sequence of source code releases over a multi-years period, or all the versions stored on an svn repository (svn or alike). Information from mailing-lists (bugs, support, ...) may also be part of these datasets. Tools in machine learning capable of dealing with this sort of data have also been investigated. Goals that may be reached in this endeavor have also been precised.

7.4. TBS

Participants: Jérémie Mary, Philippe Preux.

A new project has started on September 2012 in collaboration with the TBS company. The goal is to understand and predict the audiences of some news related websites. These websites tend to present an ergodic frequentation with respect to a context. The main goal is to separate the effect of the context (big events, election, ...) and the impact of the policies of the news websites. This research is done using data from major french media websites and also involves research of tendencies on the web (like Google Trends/ Google Flu). Used algorithms mix methods from time series prediction (ARIMA and MARSS models) and some machine learning methods (L1 penalization, SVM).

7.5. Unbalance Corporation

Participant: Rémi Coulom.

Unbalance Corporation (<http://www.unbalance.co.jp/>) is a Japanese publisher of game software. We have two license agreements with this company, for the games of Go and Hanafuda.

SIERRA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

Participant: Francis Bach.

Google Research Award: “Large scale adaptive machine learning with finite data sets”.

SIMPAF Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Numerical homogenization for models of transfer of solutes in porous media

Participants: Antoine Gloria, Zakaria Habibi.

This is a contract (2011-2012) between Inria and ANDRA. The aim of this research is to determine the effective coefficients for models of transfer of solutes in porous media. This is a numerical homogenization problem for a coupled system of convection-diffusion equations. This enters the framework of the numerical simulation for radioactive waste disposal devices.

7.2. Study of the EKINOX model of corrosion

Participants: Claire Chainais, Antoine Gloria.

This is a CNRS Contract (2012-2013) with CEA, Univ Lille1, and Univ B. Pascal. In collaboration with C.Desgranges and F. Lequien (CEA), F. Bouchon (Univ. B. Pascal), A. Gloria and C. Chainais-Hillairet are considering the model EKINOX developed at CEA for the study of the corrosion of Ni-base alloys in PWR primary water. Starting from this numerical model (leading to an explicit in time scheme), they have established a macroscopic model (a system of coupled partial differential equations). Based on this model, the aim is to propose some new numerical methods taking into account correctly the relevant time scales or scales of parameters.

7.3. Numerical methods for the DPCM model

Participants: Claire Chainais, Thomas Gallouët, Antoine Gloria.

This is a contract (2012-2014) between Inria and ANDRA. Some numerical methods have already been developed for the approximation of the DPCM model (corrosion model of an iron based alloy in the nuclear waste repository), see [4]. These methods have been implemented in the code CALIPSO developed at ANDRA. They are devoted to the simulation of the time-dependent model and based on a implicit first order in time and second order in space scheme. For this problem, we want to develop second order in time schemes which remain unconditionally stable. We also want to design new schemes for the direct computation of a steady-state. This should be done during the post-doc of Thomas Gallouët. This is work in collaboration with C. Bataillon (CEA), F. Bouchon (Univ B. Pascal) and J. Fuhrmann (WIAS Berlin).

TAO Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- The ILAB *Metis* is a close partnership with the SME **ARTELYS** whose aim is to develop a generic optimisation platform for sequential decision making that could be used for different applications. See Section 5.1 for a detailed description.

7.2. Bilateral Grants with Industry

- **PSA** – 2009-2012 (45 kEur). , side-contract to Mouadh Yagoubi's CIFRE Ph.D.;
Participants: Marc Schoenauer, Mouadh Yagoubi.
- **THALES** – 2011-2014 (40 kEur). , side-contract to Gaetan Marceau-Caron's CIFRE Ph.D.;
Participants: Marc Schoenauer, Gaetan Marceau-Caron.
- **EXQIM** – 2011-2014 (40 kEur). , side-contract to Moez Hammami's CIFRE Ph.D.;
Participants: Michèle Sebag, Moez Hammami.

TOSCA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- TOSCA Nancy had a bilateral contract with the SME Alphability on the evaluation of the Value at Risk with applications in portfolio management. This collaboration will be continued in 2013.

ABS Project-Team (section vide)

AMIB Project-Team (section vide)

ASCLEPIOS Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Inria - Mauna Kea Technologies I-Lab SIWA

Participants: Nicholas Ayache, Xavier Pennec, Irina Vidal Migallon, Marzieh Kohandani Tafreshi, Barbara André [Mauna Kea technologies], Tom Vercauteren [Mauna Kea technologies], Julien Dauguet [Mauna Kea technologies].

The I-Lab SIWA (Stitching Images and Wisdom into the Atlas) aims at maturing two key image processing technologies into real products for confocal fibered-microscopy. The first axis on content-based image retrieval (CBIR) will develop efficient and friendly tools for helping the diagnosis and for user training. The second axis on image registration will develop near real-time and robust image registration tools for mosaicking, image stabilization and super-resolution.

The opening ceremony of the I-Lab SIWA took place on Friday, November 16, 2012 in the presence of Michel Cosnard (CEO of Inria) and Gérard Giraudon (head of Inria-SAM Center). Keynotes lectures by Asclepios members were given by Xavier Pennec and the two engineers dedicated to this project: Irina Vidal Migallon and Marzieh Kohandani Tafreshi. For more information, visit: <https://lisa.sophia.inria.fr/siwa-loasis-numerique-dinria-et-de-mauna-kea-706.html>

6.2. CIFRE PhD Fellowships

6.2.1. General Electric

The work of Thomas Benseghir, *3D/2D Coronary Registration for Interventional Cardiology Guidance*, is supported by a PhD fellowship from the General Electric company.

6.3. Other contracts

The contracts Cancéropôle PACA, Philips, and Siemens are described in our previous activity reports.

6.4. National initiatives

6.4.1. ANR KaraMetria

Participants: Xavier Pennec [correspondant], Vikash Gupta, Marco Lorenzi.

KaraMetria is the concatenation of Kara ("head", "brain" in ancient Greek), and Metria ("measure"). This ANR-funded project (2010-2012, <http://sites.google.com/site/karametria/>) aims at: developing an extensible image registration framework able to map anatomical descriptors (such as sulcal lines or white matter fibers) of the brain shape from one subject to another ; providing all necessary statistical tools to compare a subject with a group or compare groups of subjects based on the aforementioned registration framework ; and identifying biomarkers of certain brain pathologies and psychiatric disorders. In particular, we target the study of a population of depressive teenagers. This project is led in collaboration with the LNAO at CEA, the MAP5 laboratory from the University Paris Descartes, and the INSERM U797 unit.

6.4.2. Consulting for Industry

- Nicholas Ayache is scientific consultant for the company Mauna Kea Technologies (Paris).

6.4.3. Collaboration with national hospitals

Asclepios is collaborating with the following 3 IHU (University Hospital Institute) in France : the IHU-Strasbourg (Pr J. Marescaux and L. Soler) on image-guided surgery, the IHU-Bordeaux (Pr M. Haïssaguere and Pr P. Jaïs) on cardiac imaging and modeling and the IHU-Pitié Salpêtrière (Dr. O. Colliot and S. Durrleman) on neuroimaging.

We also have long term collaborations with the CHU Nice and Centre Antoine Lacassagne in Nice.

ATHENA Project-Team (section vide)

BAMBOO Project-Team (section vide)

BANG Project-Team (section vide)

BEAGLE Team (section vide)

BIGS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Start-up project by T. Bastogne:

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

Status: in incubation.

Comments: Cybernano is an incubating start-up specialized in nano-cancerology, which has received the "emergence" award in 2012 from the French Research ministry for the creation of start-up based on innovative technology. Cybernano proposes innovating products to reduce the cost and control the risk during the preclinical development of nanoparticles in oncology applications. The engineering approach used by this spin-off is strongly based on the use of suited mathematical models.

7.2. Bilateral Grants with Industry

CIFRE PhD grant supervised by P. Vallois:

Industrial partner: Caisse Mutuelle du Crédit Agricole.

Title: Claim reserving for insurance.

PhD thesis of M. Geoffray Nichil.

BIOCORE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Microalgae for biofuel production

Biocore takes part in a project for assessment of microalgal biofuel productivity whose other partners are Alpha Biotech, EADS and PSA Peugeot Citroen.

BONSAI Project-Team (section vide)

CARMEN Team (section vide)

CLIME Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Clime is partner with INERIS (National Institute for Environmental and Industrial Risks) in a joint cooperation devoted to air quality forecast. This includes research topics in uncertainty estimation, data assimilation and ensemble modeling.

Clime also provides support to INERIS in order to operate the Polyphemus system for ensemble forecasting, uncertainty estimations and operational data assimilation at continental scale.

- Clime is partner with IRSN, the French national institute for radioprotection and nuclear safety, for inverse modeling of emission sources and uncertainty estimation of dispersion simulations. The collaboration aims at better estimating emission sources, at improving operational forecasts for crisis situations and at estimating the reliability of forecasts. The work is derived at large scale (continental scale) and small scale (a few kilometers around a nuclear power plant).
- Clime takes part to a joint Ilab with the group SETH (Numtech). The objective is to (1) transfer Clime work in data assimilation, ensemble forecasting and uncertainty estimation, with application to urban air quality, (2) identify the specific problems encountered at urban scale in order to determine new research directions.

CORTEX Project-Team (section vide)

DEMAR Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- An industrial technological transfer contract is ongoing with the MXM company that develops cochlear implant and artificial lens implant. MXM can perform also Ethylene Oxyde sterilization necessary for all our experimental setups used during surgery. Two DSU prototypes (named Stim'3D and Stim'nD), one miniaturized DSU (named USR24*1000) and an external controller have been developed within this frame. The associated programming environment (SENIS Manager, cf. section 5.1.2) has also been developed in this context.
- The contract with Vivaltis company that is specialized in the development of external stimulators, has been completed. We jointly developed a new advanced external FES system dedicated to clinical rehabilitation; this first wireless external stimulation architecture is now CE marked, and commercialized by Vivaltis.

This work has been awarded by the 1st Prize 2012 of the FIEEC-OSEO on Applied Research.

DRACULA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

The MIREV project, on the "Modeling of the Immune Response to support Efficient Vaccine development", submitted in 2011 to the BioAster IRT, is still in the selection process. Partners include: Sanofi-Pasteur, Altrabio, Antagene, The Cosmo Company, INSERM-I2V and Dracula Team.

DYLISS Team (section vide)

FLUMINANCE Project-Team (section vide)

GALEN Team

7. Bilateral Contracts and Grants with Industry

7.1. General Electric HealthCare

- Compressed Sensing Digital Subtraction Rotational Angiography [PhD thesis H. Langet: 2009-2012]:
- Guide-wire Segmentation and Tracking of in interventional Imaging [PhD thesis N. Honnorat: 2008-2012]

7.2. Intrasene

Modeling, segmentation and registration of low gliomas brain tumors [PhD thesis S. Parisot: 2010-2013]

7.3. Siemens

Graph-based Knowledge-based Segmentation of the Human Skeletal Muscle in MR Imaging [PhD thesis P-Y. Baudin: 2009-2012]

GENSCALE Team

7. Bilateral Contracts and Grants with Industry

7.1. Sequence Comparison, Korilog

Intensive bank-to-bank comparison with Korilog : this collaborative project between the Korilog company and the GenScale team aims to investigate new research directions in the bank-to-bank sequence comparison problem. Two research axes are followed : constrained exploration of the search space and adaptation of the ORIS algorithm, developed by D. Lavenier for fast DNA comparison, to the protein sequences. It is funded for 3 months (Nov. 2012 - Feb. 2013), including the visit of assistant professor Van-Hoa Nguyen from Vietnam.

KoriPlast: this project is a cooperation between GenScale and the Korilog company, it is funded by Région Bretagne from June 2011 to Nov. 2012. It aims to industrialize the PLAST software prototype, previously developed in GenScale, that performs intensive genomic bank-to-bank comparisons. The commercial version is now called KLAST <http://www.korilog.com/index.php/KLAST-high-performance-sequence-similarity-search-tool.html>

7.2. Peapol

The Peapol project is funded by Sofiproteol company whose mission is to develop the French vegetable oil and protein industry, open up new markets, and ensure an equal distribution of value among its members. The Peapol project counts two collaborators, Biogemma, and INRA, the latter working in collaboration with the Genscale team, in charge of algorithmic research in the context of the project. This collaboration enabled to hire in the Genscale team Raluca Uricaru for 18 months on an INRA post doctoral position, followed by Suzete Alves-Carvalho (engineer).

7.3. Rapsodyn

RAPSODYN is a long term project funded by the IA French program (Investissement d'Avenir) and several field seed companies, such as Biogemma, Limagrain and Euralis. The objective is the optimisation of the rapeseed oil content and yield under low nitrogen input. GenScale is involved in the bioinformatics workpackage, in collaboration with Biogemma's bioinformatics team, to elaborate advanced tools dedicated to polymorphism.

IBIS Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Genostar

Participant: François Rechenmann.

Genostar, an Inria start-up created in 2004, provides bioinformatics solutions for the comparative analysis of bacterial genomes, proteomes and metabolomes. Genostar's software suite performs the annotation of sets of genomic sequences, *i.e.*, the identification of the coding sequences and other features, followed by the prediction of the functions of the gene products. The modules which make up the software suite were originally developed within the Genostar consortium and the HELIX project team at Inria Grenoble - Rhône-Alpes. The software suite also includes the modeling and simulation tool GNA developed by members of IBIS (Section 4.1). Genostar offers a comprehensive service line-up that spans genome sequencing, read assembly, annotation, and comparison. Genostar thus works with trusted subcontractors, each specialized in state-of-the-art sequencing technologies. François Rechenmann is scientific consultant of the company. For more information, see <http://www.genostar.com>.

6.2. BGene

Participant: Johannes Geiselmann.

BGene is a start-up company of Université Joseph Fourier in the field of DNA engineering. BGene proposes efficient and custom-made modifications of bacterial genomes, leaving no scars or antibiotics resistance genes. The company has know-how and expertise at all stages of the development process, including the *in-silico* design of a desired construction, the choice of the right genetic tools, and the delivery of the finished product. Former IBIS-member Caroline Ranquet and Johannes Geiselmann are co-founders of BGene, together with Marie-Gabrielle Jouan (Floralis, Université Joseph Fourier).

MACS Project-Team (section vide)

MAGIQUE-3D Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contracts with TOTAL

- Depth Imaging Partnership (DIP)
Period: 2010 January - 2012 december, Management: Inria Bordeaux Sud-Ouest, Amount: 3600000 euros. 150 000 euros have been devoted to hire an associate engineer (from Oct. 2010 to Sept. 2012).
- Schémas en temps d'ordre élevé pour la simulation d'ondes élastiques en milieux fortement hétérogènes par des méthodes DG.
Period: 2010 November - 2013 October, Management: Inria Bordeaux Sud-Ouest, Amount: 150000 euros.
- Propagateurs optimisés pour les ondes élastiques en milieux anisotropes
Period: 20November - 2014 October, Management: Inria Bordeaux Sud-Ouest, Amount: 160000 euros.
- RTM en milieux hétérogènes par équations d'ondes élastiques
Period: 2011 November - 2014 October, Management: Inria Bordeaux Sud-Ouest, Amount: 160000 euros.

MAGNOME Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contracts with Industry

SARCO, the research subsidiary of the Laffort group, has entered into a contract with MAGNOME to develop comparative genomics tools for selecting wine starters. This contract will permit SARCO to take a decisive step in the understanding of oenological microorganisms by obtaining and exploiting the sequences of their genomes. Comparison of the genomes of these strains has become absolutely necessary for learning the genetic origin of the phenotypic variations of oenological yeasts and bacteria. This knowledge will permit SARCO to optimize and accelerate the process of selection of the highest-performing natural strains. With the help of MAGNOME members and their rich experience in comparative analysis of related genomes, SARCO will acquire competence in biological analysis of genomic sequences. At the same time, MAGNOME members will acquire further experience with the genomes of winemaking microorganisms, which will help us define new tools and methods better adapted to this kind of industrial cell factory.

7.2. Grants with Industry

The French Petroleum Institute (*Institut français de pétrole-énergies nouvelles*) is coordinating a 6 M-Euro contract with the Civil Aviation Directorate (*Direction Générale de l'Aviation Civile*) on behalf of a large consortium of industrial (EADS, Dassault, Snecma, Turbomeca, Airbus, Air France, Total) and academic (CNRS, INRA, Inria) partners to explore different technologies for alternative fuels for aviation. The CAER project studies both biofuel products and production, improved jet engine design, and the impact of aircraft. Within CAER MAGNOME via CNRS, works with partners from Grignon and Toulouse on the genomics of highly-performant oleaginous yeasts.

MASAIE Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Contract with IAEA

Anopheles arabiensis is the target of a sterile insect technique (SIT) program in Sudan. Success will depend in part upon reasonable estimates of the adult population in order to plan the sizes of releases. It is difficult to obtain good estimates of adult population sizes for this mosquito because of the low density of the populations and also because the temporal and spatial distribution of *Anopheles arabiensis* is very dynamic. We have developed a compartmental model capable of predicting the range of adult populations of *Anopheles arabiensis* in two study sites in the North of Sudan. We have provided a software that is “user friendly” and that is able to give an estimate of the whole male and female population for the two geographical areas. A screenshot of the soft user interface is presented in Figure 3 . This work is done in collaboration with Yves Dumont (AMAP, CIRAD).

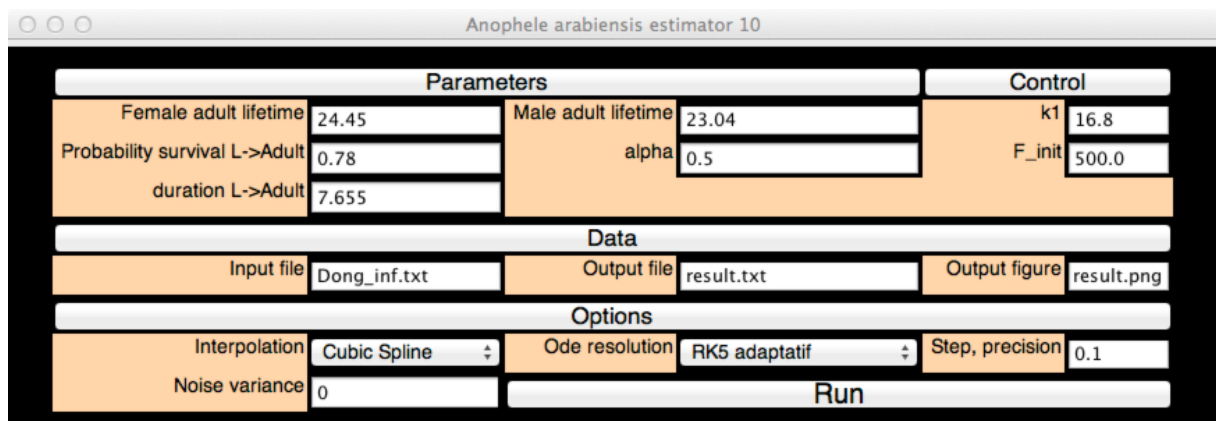


Figure 3. Anopheles estimator: screenshot of the soft user interface

MNEMOSYNE Team (section vide)

MODEMIC Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. CAFE

Participants: Céline Casenave, Jérôme Harmand, Alain Rapaport.

The objective of the CAFE European project is to provide new paradigms for the smart control of food processes, on the basis of four typical processes in the areas of bioconversion, separation, preservation and structuring, see details in <http://www.cafe-project.org>. The novelty of the project lies in the capacity of combining PAT (Process Analytical Technology) and sensing devices with models and simulation environment with the following objectives:

1. to extract as much as possible information from the process/plant in the form of precise estimations of unmeasured variables defining, in particular, product quality, and of physical parameters changing as the process dynamics does or difficult to know beforehand;
2. to save and encode the information in a reliable and usable way, basically via physical/deterministic models;
3. to develop control methods to keep uniform quality and production, despite the variability in the raw material and/or to respond to sudden changes in the demand.

MODEMIC is involved in the wine making supervision part (see Section 6.2.4) and in the ice cream crystallization control part (see Section 6.2.5).

7.2. DIMIMOS

Participants: Jérôme Harmand, Alain Rapaport.

DIMIMOS is an ANR SYSTERRA 2008 project of 4 years headed by the UMR Microbiologie du Sol et de l'Environnement (INRA Dijon).

This fundamental research project aims at better understanding the functional microbial soil ecosystems with respect to the turnover of soil organic matter (SOM). More specifically, we aim at evaluating the role of the microbial diversity in transforming SOM, in order to better manage the carbon in its biochemical global cycle within agro-ecosystems. This project must deliver new insights for managing agricultural productivity (allow better agricultural practices) while maintaining a high quality of soil over the long term.

For the final stage of the project, the theoretical results obtained in Section 6.1.7 need to be confronted with the data provided by the partners.

7.3. DISCO

Participants: Fabien Campillo, Chloé Deygout, Bart Haegeman, Jérôme Harmand, Annick Lesne, Claude Lobry, Alain Rapaport, Tewfik Sari.

DISCO (Multi-scale modelling bioDIversity Structure COupling in biofilms) is a three years project funded by the ANR SYSCOMM since the end of 2009, that aims at developing and studying computational and mathematical models of biofilm dynamics, taking into account the biodiversity (distribution of bacteria species) and spatial structure; see details in <https://sites.google.com/site/anrdisco/>.

Several “go back” between simulation models and experiments in plug-flow reactors performed at IRSTEA Antony have been conducted during the two postdoctoral years of C. Deygout hired by the project. A first paper on the simulation of a multi-scale model has been published [17] and a second one on the confrontation with experiments is in preparation (see Section 6.2.2).

At a macro-scale, the team has studied several extensions of the chemostat model dedicated to microbial ecosystems with biofilm (see Section 6.1.1 and the publication [21]).

A new collaboration has been launched with the HBAN team at IRSTEA Antony, within this project, about the modelling of cellulose degradation. Cellulose is typically available in small balls (but ten times larger than the average size of microorganisms) that are first converted by enzymatic activity into carbon substrate that can then be assimilated by the microorganisms. Some of the microorganisms are attached to these balls, creating a particular aggregates structure.

An IBM for the degradation of one cellulose bead (dozens of micrometers in diameter) by cellulolytic bacteria has been developed. Our aim is to determine the macroscopic degradation behavior. The initial stages of the degradation process may involve a very limited number of bacteria that cannot be properly modelled by classical models based on deterministic equations (see Section 6.2.3 and communications [44] and [43]).

The duration of the project has been extended by the ANR to May 2013, in order for the team to prepare a final restitution at Paris in spring 2013.

7.4. MODECOL

Participant: Fabien Campillo.

The ANR SYSCOMM Project MODECOL (January 2009/June 2012) involves three Inria project-teams (MODEMIC, MAESTRO and TOSCA) with the UMR Ecobio (Ecosystèmes, Biodiversité, Evolution, Rennes), the University of La Rochelle and the Universities of Houston and Berkeley. The aim of the Inria component is to propose individual-based models for terrestrial prairial plant communities' dynamics in the context of water purifying from nitrate and pesticides. The results of the Inria component have been published [13] This year was also dedicated to the edition of a special issue of Ecological Modelling on "Modelling clonal plant growth" [22]. See <http://www-sop.inria.fr/members/Fabien.Campillo/software/ibm-clonal/> for more details.

MOISE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contracts with Industry

- A 4-year contract named ReDICE (Re Deep Inside Computer Experiments) with EDF, CEA, IRSN, RENAULT, IFP on the thematic computer experiments
- A 3-year contract with CEA Cadarache related to Simon Nanty's PhD.
- A 3-year contract with EDF: project MeCSiCo (coupling methods for the simulation of river flows): see [4.4](#)
- A 3-year contract with ADEME on the thematic "Stochastic Downscaling Method": see [5.4](#) .

MORPHEME Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

6.1.1. Galderma Sophia-Antipolis

Participants: Sylvain Prigent, Xavier Descombes.

Contribution of multi and hyperspectral imaging to skin pigmentation evaluation. Contract #4383.

In collaboration with Joisane Zerubia from Ayin team.

6.2. Bilateral Grants with Industry

6.2.1. CNES Toulouse and TAS Cannes

Participants: Mikael Carlavan, Laure Blanc-Féraud.

Optimization of the compression-restoration chain for satellite images.

NEUROMATHCOMP Project-Team (section vide)

NUMED Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

SANOFI Pasteur: second contrat on vaccine degradation study.

7.2. Bilateral Contracts with Industry

SERVIER: four years frame contract.

PARIETAL Project-Team (section vide)

POMDAPI Project-Team

4. Bilateral Contracts and Grants with Industry

4.1. Bilateral Contracts with Industry

Agence Nationale pour la gestion des Déchets RAdioactifs (Andra) Pomdapi takes part in 2 projects in the framework of the Andra–Inria research agreement;

- Ph. Hoang–Thi–THao is preparing a PhD (surpervised by J. E. Roberts, C. Japhet and M. Kern) on space–time domain decomposition methods for modeling transport in porous media.
- M. Kern is advising Andra in the choice of high performance linear algebra solvers for the heterogeneous problems encountered in flow simulations.

4.2. Bilateral Grants with Industry

Martin Vohralík, conjointement avec Vivette Girault (Université Pierre et Marie Curie), dirigent le projet **ERT (Equipe de Recherche Technologique)** entre le Laboratoire Jacques-Louis Lions (LJLL) et l’Institut Français du Pétrole Energies Nouvelles (IFPEN) sur la *Récupération d’huile assistée et séquestration géologique du CO₂: adaptation de maillage, contrôle d’erreur a posteriori et autres techniques avancées*. Projet mené en partenariat avec des industriels afin de « lever des blocages technologiques ». 9 chercheurs du LJLL, 6 chercheurs de l’IFPEN, 2 doctorants, stagiaires.

REO Project-Team (section vide)

SAGE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. ANDRA: Numerical methods for reactive transport

Participants: Édouard Canot, Jocelyne Erhel, Souhila Sabit.

Title: Numerical methods for reactive transport.

Time: three years from October 2010.

Partner: ANDRA Coordination: J. Erhel, with G. Pépin (ANDRA)

SERPICO Team

7. Bilateral Contracts and Grants with Industry

7.1. Innopsys: Methods and algorithms for tissue microarrays image analysis

In collaboration with Magellium company and Institut Gustave Roussy, Innopsys plans to develop new image analysis software to be included in the INGRID platform developed by Megellium company. New statistical methods and algorithms will be investigated by SERPICO for:

- segmentation and detection of deformable cell contours and cell nuclei in 2D fluorescence tissue microarray images;
- deconvolution and superresolution of fluorescence microarray imaging.

The three-year contract supports the PhD thesis of Alice Bergonzoni (2013-2015).

SHACRA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. *HelpMeSee and Sensegraphics*

The swedish company Sensegraphics and the NGO HelpMeSee have signed for 2 contracts for technology transfer. The contract focus on the design of a simulator to treat cataract surgery using the MSICS (Manual small incision cataract surgery) technique.

7.1.2. *Digital Trainers*

The company Digital Trainers has signed a two year contract and a two year license with our group for the transfer of our suture simulation technology. The contract aims at improving the simulation by using an adaptive model for the suture thread and continuous constraints for the interaction with the soft tissues. Haptic feedback will also be investigated.

7.1.3. *Collin*

We have started a collaboration with INSERM - UMR-S 867 (minimal invasive and robotized otological surgery) Faculté de Médecine Paris Diderot Paris 7 and with the company Collin which is developing some activities in the domain of the head and neck (middle ear implants, surgical instruments, surgical navigation, ...). The objective of this project is to obtain a simulation tool applied to the ear surgery for both training and planning of middle ear surgery. Guillaume Kazmitcheff is doing his PhD in the context of this collaboration: he is paid by a CIFRE contract with Collin, he is mainly working with the INSERM team but the design of the simulation is done in collaboration with our group and he is enrolled in the university of Lille 1.

SISYPHE Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Renault contract: Modeling, Control, Monitoring and Diagnosis of Depollution Systems

Participants: Pierre-Alexandre Bliman, David Marie-Luce, Michel Sorine.

This work is done in cooperation with Renault in the framework of a CIFRE contract. The issue of depollution has become a central preoccupation for the automotive industry, and the increased severity of the emission norms necessitates tight modeling and control solutions. We have worked on simple models for two devices, namely the NO_x-trap and the SCR (Selective catalytic reduction). Observers have been obtained and tested against real-world data. See [16].

Based on the later, a control law has been obtained this year, for the control of the NO_x-trap. This control law is defined by setting thresholds for the estimated NO_x coverage fraction, to switch between storage mode and purge mode. These thresholds are optimal in stationary conditions, in the sense that they minimize the gas consumption under given pollutant emission constraint. Adequate moving window is fitted to define the switching values in non-stationary conditions. The algorithm has led to successful numerical tests.

6.2. CARMAT SAS contract: Modeling and control of a Total Artificial Heart

Participants: Julien Bernard, Michel Sorine.

This is a cooperation with CARMAT SAS (Suresnes, France) on the development of a Total Artificial Heart.

This fully implantable artificial heart is designed to replace the two ventricles, possibly as an alternative to heart transplant from donors. In a first time, it will be used as a end-of-life treatment for patients waiting for a transplant. The first patients may receive this artificial organ in less than three years.

Compared with the mechanical hearts used up today, that are mainly LVAD (left ventricular assist devices) or with its main concurrent, the Abiomed implantable replacement heart system (Abiomed), the present artificial heart is designed to be highly reliable and with a low thromboembolism rate. It will allow longer waiting periods for heart transplants and even, in a next future, may be an alternative to these transplants.

The prosthesis uses two controlled pumps that are not in direct contact with the blood, eliminating hemolysis risk and is equipped with miniature sensors in order to have a full control of the heart rate and arterial blood pressure. Our objective is to improve the control strategies by mimicking the physiological feedback loops (Starling effect, baroreflex loop, ...) to allowing patients to live as normally as possible. In a first step, this year we have modeled the prosthesis with its present controller and its testbed, a “mock circulation system” (MCS). This year we have tried some control algorithms with the MCS.

6.3. LK2 contract: Tight glycaemic control for Intensive Care Units

Participants: Alexandre Guerrini, Michel Sorine.

This work on tight glycaemic control (TGC) for ICU started in September 2008 in the framework of the CIFRE contract of Alexandre Guerrini with the small medtech company LK2 (Tours, France). It is in collaboration with the Intensive Care Unit (ICU) of Chartres Hospital headed by Dr Pierre Kalfon. For the medical context of this study, see [90].

Blood glucose has become a key biological parameter in critical care since publication of the study conducted by van den Berghe and colleagues [104], who demonstrated decreased mortality in surgical intensive care patients in association with TGC, based on intensive insulin therapy. However, two negative studies were recently reported, which were interrupted early because of high rates of severe hypoglycaemia, namely the VISEP study [85] and the Glucontrol trial.

After having studied a possible origin of the failure of the recent study NICE-SUGAR, we have worked on more robust control algorithms based on a database of representative “virtual patients” [87].

In this study, we have developed efficient monitoring and control tools, now marketed by LK2 that will help clinicians and nursing staff to control blood glucose levels in ICU patients, in particular to avoid hyperglycaemia superior to 10 mmol/l and hypoglycaemia episodes. Our first controller has been assessed in the study CGAO-REA (see 4.3) with more than 3500 included patients. The controller determines the insulin infusion rate on the basis of the standard available glycaemia measurements despite their irregular sampling rate.

STEEP Exploratory Action

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

EADS Astrium We have been sub-contractors of EADS Astrium in several national and international application-oriented projects. This activity is related to the previous research in computer vision of some team members.

7.2. Bilateral Grants with Industry

ARTELIA We have agreed on a CIFRE scheme for a PhD on the topic: Material flow and environmental impact analyses at local scales, from labor pools to regions. We are currently waiting for the validation by ANRT.

VIRTUAL PLANTS Project-Team (section vide)

VISAGES Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contracts with Industry

7.1.1. Siemens

duration: 5 years from 2011/10/26

In the context of the Neurinfo imaging platform, a partnership between Siemens SAS - Healthcare and University of Rennes 1 was signed in October 2011 for 5 years. This contract defines the terms of the collaboration between Siemens and the Neurinfo platform. The Neurinfo platform has received work in progress (WIP) sequences from Siemens in the form of object code for evaluation in the context of clinical research. The Neurinfo platform has also received source code of selected MRI sequences. This a major advance in the collaboration since it will enable the development of MRI sequences on site.

7.1.1.1. *TransIRMf project*

Participants: Christian Barillot, Jean-Yves Gauvrit, Jean-Christophe Ferré, Elise Bannier, Camille Maumet, Isabelle Corouge.

duration : 24 months, from 01/10/2010

The objective of this project is to set up and validate acquisition and data processing pipelines for metabolic and functional MRI. Acquisition techniques comprise innovative block design and event related paradigms based on various stimuli (visual, auditive) and use various MRI sequences (BOLD, ASL). Paradigms were selected to cover a large scope of potential applications. The protocol imaging namely includes a BOLD fMRI resting state paradigm, an n-back working memory paradigm for BOLD fMRI, as well as and for the first time, for functional ASL. An emotional prosody recognition task was implemented, also for the first time, in an event related BOLD fMRI context. Data were acquired on 30 healthy subjects. Processing of these data is in progress based on inhouse pipelines (e.g., template construction using DARTEL, PVE correction for ASL data). This grant was awarded in collaboration with Biotrial within the CRITT-Santé Bretagne program.

ACES Project-Team

5. Bilateral Contracts and Grants with Industry

5.1. Bilateral Contracts with Industry

5.1.1. *Energy saving mechanisms in smart homes using ambient computing principles*

- Partner : EDF - R&D
- Starting: 01/06/2010, ending : 01/10/2013

This project is funded by EDF group, leading energy producer in Europe. It started in June 2010. Its ends in June 2013. Its goal is to study the use of ambient computing principles for the management of electricity consumption in residential habitat. It focusses on two main objectives: (1) to define scenarios based on home people activities, and (2) to propose an implementation of these scenarios using ambient computing mechanisms studied in the Aces project. The main results are presented in section [4.3](#) .

ADAM Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Thales This contract is associated to the CIFRE PhD thesis of Jonathan Labéjof between ADAM and the Thales company. The goal of the project is to study the evolution of heterogeneous service-oriented architectures. We address two problems. First, we study some various forms of support for heterogeneity in service architectures in terms of communication protocols and software component personalities. Second, we propose solutions for systems which are agile and respond smoothly to changes in their execution contexts. Overall, the goal of this project is to propose to design a model for adaptability, a runtime infrastructure and to provide some means by which these two levels can be causally connected and kept consistent.

Participants: Jonathan Labéjof, Philippe Merle, Lionel Seinturier.

France Telecom DigiHome is a contract with France Telecom to study the adaptation of software systems in distributed digital home environments. These environments and their extensions (vehicles, holiday homes, work at home) are now invaded by a multitude of communicating objects dedicated to content management, viewing multiple video streams, or information sharing within a community network. These objects offer services with capacities of configuration and remote administration, and advanced interactions with the end-user or between devices or services. Given the lack of universality of proposals from IT and device companies and the lack of interoperability of these devices and services, it becomes necessary to offer a virtual environment named Extended Digital Home to encompass and unify these proposals and make life easier for the inhabitants. First, we will propose a unified model for integrating devices and services inside and outside the home with a continuum between private and public lives. Second, we will study an energy model to save energy in this extended environment. Overall, the goal of this project will be to propose to design a model for a cloud inside home and to provide some means to reduce the energy using on media devices. First results have been published in [115] and [99]. This contract is complemented by a second one, which is the CIFRE contract associated to Rémi Druilhe PhD thesis.

Participants: Rémi Druilhe, Laurence Duchien, Romain Rouvoy, Lionel Seinturier.

Kaliterre *Web Energy Archive* (WEA) is a project funded by the French Environment and Energy Management Agency (ADEME) to archive the energy consumption of Web sites that are accessible on the Internet. The objective of this project is to constitute an international referential on the evolution of the Web energy consumption. The adopted methodology focuses on the quality of experience and measures the energy consumed by users when they browse a specific website. The benefit of this approach is that it is representative of Internet usages and takes into account the variety of Web browsers and computer architectures. The software solution developed by this project will build on the **HTTP Archive project**, initiated by Google, and will extend it with consumption measures that will be collected by our PowerAPI library. The objective of this collaboration is to port our solution to the Windows operating system.

Participants: Aurélien Bourdon, Romain Rouvoy.

ALGORILLE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- In 2012, SUPÉLEC had 2 contracts with Quartet Financial System about parallel and distributed applications processing flows of financial data (the first one on PC clusters, and the second on NUMA computing nodes). This industrial research collaboration is continuing in 2013.
- In 2012 SUPÉLEC has achieved an industrial contract with Thales Underwater Systems about parallelisation on GPU of sonar signal processing algorithms.
- In 2012 SUPÉLEC has achieved an industrial contract with CGGVeritas about the parallelization on GPU of seismic data decompression.
- In 2012 SUPÉLEC has started 2 contracts with EDF R&D about the development of co-simulators for electrical smart Grids, including control parallelism issues.

ARLES Project-Team (section vide)

ASAP Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Technicolor

Participants: Anne-Marie Kermarrec, Alexandre Van Kempen.

Since 2010, we have had a contract with Technicolor for collaboration on peer-assisted approaches for reliable storage. In this context, Anne-Marie Kermarrec has been the PhD advisor of Alexandre van Kempen since 2010.

7.2. Orange Labs

Participants: Ali Gouta, Anne-Marie Kermarrec.

We have had a contract with Orange Labs for collaboration on peer-assisted approaches for caching and recommendation in streaming applications. In this context, Anne-Marie Kermarrec has been the PhD advisor of Ali Gouta since 2012.

ASCOLA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Cooperation with SIGMA group

Participants: Thomas Ledoux, Simon Dupont.

In 2012, we have started a two-fold cooperation with Sigma Group (<http://www.sigma.fr>), a software editor and consulting enterprise. The cooperation consists in a joint (a so-called Cifre) PhD on eco-elasticity of software for the Cloud and the sponsorship of several engineering students at the MSc-level.

As a direct consequence of the increasing popularity of cloud computing solutions, data centers are amazingly growing and hence have to urgently face with the energy consumption issue. The aim of Simon Dupont's PhD, started in November 2012, is to explore the *software elasticity* capability in Software-as-a-Service (SaaS) development to promote the management of SaaS applications that are more flexible, more reactive to environment changes and therefore self-adaptive for a wider range of contexts. As a result, SaaS applications become more elastic and by transitivity more susceptible to energy constraints and optimization issues.

ATLANMOD Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Three technology transfer contracts with software companies were signed this year.

7.1.1. Steria

A first collaboration with Steria Ouest (located in Nantes) is resulting from the presentation of our activities during one of their regular Board of Architects meeting. The identified objective of this initial joint action was to guide and advice them to migrate an internal legacy application to model driven approach and related technologies, relying on our expertise about modeling and the Eclipse ecosystem. This has notably allowed us to get useful feedback on the benefits and drawbacks currently encountered when applying MDE and associated techniques in the context of real applications.

7.1.2. MIA-Software

Since several years, AtlanMod and Mia-Software are actively collaborating around the topic of Model Driven Reverse Engineering (MDRE), i.e.; the combined use of different model-based techniques to solve real reverse engineering problems. This has resulted in the successful creation and development of two open source Eclipse projects, namely Eclipse-MDT MoDisco (providing a generic and extensible MDRE framework) and Eclipse-EMFT EMF Facet (providing a dynamic model extension framework), both reaching today an industrial maturity level.

However, for these technologies to be definitely adopted and deployed in the context of very large systems handling huge data volumes, some remaining scalability issues still have to be addressed. Thus, scalability of model-driven techniques is one of the main challenges MDE is facing right now. In this context, AtlanMod has joined forces with MIA-Software as part of an Inria technology transfer action. This initiative is devoted to the development of new generation MDE techniques, for model creation and general handling, that effectively scale up. Among the different research challenges behind the MDE scalability and performance improvement, the following ones have been explored in the context of this collaborative action:

- **Model random access.** Advanced use of on-demand lazy loading techniques;
- **Model clustering and slicing.** Advanced use of semantic grouping and partial loading techniques;
- **Model virtualization.** Transparent and on-demand access to different views on a same model;
- **Lazy evaluation of model transformation.** On-demand lazy execution of transformations;
- **Incremental model transformation.** Partial model access and transformation execution;
- **Multi-threaded model transformation.** Parallelization of both model accesses and rule executions.

7.1.3. WebRatio

AtlanMod has helped WebRatio and the University of Trento in the definition (to be provided as an answer to the corresponding OMG RFP) of IFML, a modeling language for designing user interaction flows (not limited to the Web). Such a language should be: Extremely compact (no useless overhead), Effective (allows to model exactly what users want), Efficient (grants high reusability of model fragments), Easy to learn (very low learning curve), Comprehensive (covers most of the user interaction needs), Open and extensible (for covering any ad-hoc logic) and Platform independent (addressing any type of user interface device).

For more information about IFML - Interaction Flow Modeling Language see ⁵.

⁵<http://www.ifml.org/>

AVALON Team (section vide)

CEPAGE Project-Team (section vide)

CIDRE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- **DGA PEA (Exploratory Study Program) contract (2011-2012): « PREVA - Security of the ad hoc routing protocols in the context of future tactical military networks »**

During the DGA-funded PREVA project ending in January 2013, we analyzed secure ad hoc routing in the context of military tactical networks. We first analyzed which routing protocols were the most suited for each type of tactical networks (Joint and Sub-Joint Tactical Groups, vehicular ad hoc networks, Futur Integrated Soldier Technologies (FIST) troopers and sensor networks assisting the troopers). We also considered the various security technologies (both crypto-based proactive mechanisms and intrusion detection-based reactive mechanisms) that could be used to protect each selected ad hoc routing protocols. Finally, we built a demonstrator implementing the various selected protocols and security mechanisms.

This study is led in cooperation with OPEN, an IT service provider located in Rennes.

- **DGA contract (2012-2013): « CAPALID »**

The CAPALID project aims at building a state of the art of off-the-shelf solutions for supervision systems in distributed environments. Our work was at first to make a state of the art of the research activities for Intrusion detection systems, correlation systems and visualization systems. On a second phase, the goal was to define an assessment methodology of these types of tools. Finally, this methodology will be applied by Amossys, our partner in the project, to evaluate the best off-the-shelf tools that have been retained in the context of the project. This study is led in cooperation with Amossys, a SME located in Rennes.

- **Technicolor contract (2011-2014): « Data Aggregation in Large Scale Systems »**

The theme of this contract focuses on the management of massively distributed data sets. Briefly, our goal is to provide a lightweight yet continuous flow of aggregate and relevant data from a very large number of distributed sources to a management system. Collaborative data aggregation are relevant mechanisms that could help in securely providing digests of information. However, an important aspect that we want to preserve is the privacy of the aggregated information. This is of particular interest for Telco operators or software/hardware providers in order to smoothly manage the current state of their deployed platforms, allowing accordingly to develop new applications based on quick reactions/optimizations to identify and handle services inconsistencies.

This study is conducted in cooperation with the Inria project Dionysos.

7.2. Bilateral Grants with Industry

- **Amossys: « Evaluation of intrusion detection mechanisms »**

The PhD of Georges Bossert is done in the context of a Cifre contract with the SME Amossys (<http://www.amossys.fr/>).

- **Orange Labs: « Data persistence and consistency in ISP infrastructures »**

Pierre Obame is doing his PhD thesis in the context of this cooperation with Orange Labs at Rennes. The theme of this project is to propose a distributed storage system dedicated to users who access Internet via a Digital Subscriber Line (DSL) technology. This system aims at guaranteeing data availability, persistency, and low access latency by fully exploiting millions of home gateways and the hundreds of Points of Presence (POP) of an Internet Service Provider (ISP) infrastructure.

- **DGA-MI: « Security events visualization »**

The PhD of Christopher Humphries is done in the context of a cooperation with DGA-MI. Due to the generalization of logging systems, security analysts are now overwhelmed by data when they want to obtain more informations. Manual inspection is clearly not possible anymore, and automated systems such as correlators are showing their limits. Visualization is a promising field. Visualization allows to build concise and often aesthetic representations of systems and events. In this project, we aim at proposing ways to evaluate current visualization solutions and to propose new ones dedicated to security events analysis, for instance for forensic purposes.

- **DGA-MI: « Alerts Correlation Taking the Context Into Account»**

The PhD of Erwan Godefroy is done in the context of a cooperation with DGA-MI. This PhD just started in November 2012.

DANTE Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- A bilateral contract has been signed between the DANTE Inria team and **ACT750** to formalize their collaboration in the context of churn prediction.
- A bilateral contract has been signed between the DANTE Inria team and **KRDS** to formalize their collaboration in the context of Facebook marketing / cascade analysis.
- A bilateral contract has been signed between the DANTE Inria team and **HiKoB** to formalize their collaboration in the context of the Equipex FIT (Futur Internet of Things) Fit is one of 52 winning projects in the Equipex research grant program. It will set up a competitive and innovative experimental facility that brings France to the forefront of Future Internet research. FIT benefits from 5.8 euros million grant from the French government Running from 22.02.11 – 31.12.2019. The main ambition is to create a first-class facility to promote experimentally driven research and to facilitate the emergence of the Internet of the future.

7.2. Inria Alcatel-Lucent Bell Labs joint laboratory

Participants: Isabelle Guérin-Lassous, Paulo Gonçalves, Thomas Begin, Éric Fleury, Doreid Ammar, Mohamad Jaber.

Traffic awareness, Flow analysis, Flow scheduling, Sampling, Flow-based routing

Former RESO team participated to the ADR (Action de Recherche/Research Action) "Semantic Networking" (SEM- NET), one of the three ADRs of the Inria ALCATEL-LUCENT BELL LABS joint laboratory. This ADR started on January 1st 2008 and formally ended in October 2012. I. Guérin Lassous and L. Noirie are the respective coordinator for Inria and for ALCATEL-LUCENT of the ADR SEMNET.

In 2013 the research axes of the Joint Lab will be renewed and a new one entitled "Network Science" will involve the participation of the research team DANTE.

DIONYSOS Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. ADR Selfnets

Participant: Bruno Tuffin.

We participate to the common lab ALU-Inria within the “Action de Recherche” SELFNETS, on pricing issues in inter-domain. The goal is to produce economic incentives for intermediate autonomous systems to forward the traffic of concurrent providers and to analyze the handover between mobile providers from an economic point of view.

6.2. Cifre contract on QoE-aware network adaptation

Participants: Adlen Ksentini, Gerardo Rubino.

This is a Cifre contract (2009-2012) (PhD thesis supervision) with Viotech Communication, on network adaptation for multimedia traffic by using QoE metrics. This work is done in the context of the FP7 ALICANTE project.

6.3. Cifre contract on LOCARN: Low Opex and Capex Architecture for Resilient Networks

Participants: Adlen Ksentini, Bruno Sericola, Yassine Hadjadj-Aoul.

This is a Cifre contract (2012-2015) (PhD thesis supervision) with Orange labs., on evaluating and developing a new plug-and-play routing protocol (called Low Opex and Capex Architecture for Resilient Networks – LOCARN), which do not require any network management and configuration.

6.4. Data-aggregation for large-scale distributed networks

Participants: Bruno Sericola, Romaric Ludinard.

We started a 3-year (2011 – 2014) bilateral project with Technicolor R & D, France, on data-aggregation for large-scale distributed networks. Along with the ubiquity of data and computing devices, comes the complexity of extracting and gathering relevant information for management purposes. The very distributed nature of sources of data (be they partially local applications at user’s place, or hardware as gateways), as well as their ever increasing number prohibit a systematic and exhaustive gathering on a single (or few) central server for offline analysis. In this context, collaborative data aggregation, where some computing resources collaborate securely to provide digests, appears as an interesting application for both scalability and efficiency. Moreover, collecting information at a large scale pose the problem of privacy and data aggregation may allow preserving the privacy while collecting data.

6.5. IPChronos

Participants: Sofiane Moad, Pantelis Frangoudis, Yassine Hadjadj-Aoul, Adlen Ksentini, Bruno Sericola.

We are working in the 2-years (September 2011 – September 2013) FUI Project IPChronos, where the main focus is in the use of the IEEE 1588 synchronization protocol over IP. Our contribution focuses on developing analytical models to estimate, basing on the IEEE 1588 protocol, the end-to-end delay. IPChronos is led by ORALIA SPECTRACOM, and the partners are IPLabel and our team.

6.6. Celtic QuEEN

Participants: Sofiene Jelassi, Gerardo Rubino.

We started a 3-year Celtic project (end 2011-end 2014) called QuEEN: Quality of Experience Estimators in Networks. The project objectives are: to develop automatic QoE measure modules for Web services and applications, and to organize these measure modules as a network of cooperative agents in order to allow each member to take advantage of the measures of the others. Dionysos is involved in most of the activities of the project, and it is expected that QuEEN will benefit from our experience in developing the PSQA technology. QuEEN is a large project (22 European partners); the project leader is Orange Labs, in Sophia Antipolis.

DISTRIBCOM Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. HIMA

High Manageability (HiMa) is a research team hosted by the virtual joint research lab between Alcatel-Lucent Bell Labs France and Inria. This team is in its last year of existence, and most of its activity is now absorbed by the UniverSelf Eu IP (see below). DistribCom is involved in two topics: joint fault diagnosis in IMS networks and services (Carole Hounkonnou's thesis), and the early detection of anomalies in networks by analyzing the timed behavior of protocols (Aurore Junier's thesis). This work resulted in two publications at CNSM'12, and two joint patents on early fault detection and on the graceful maintenance of OSPF networks.

FOCUS Project-Team (section vide)

FUN Team

6. Bilateral Contracts and Grants with Industry

6.1. Etineo Partnership

Participants: Roudy Dagher, Xu Li, Fadila Khadar, Nathalie Mitton [correspondant].

EtiPOPS will focus on portability and flexibility of GOLIATH on several hardwares and in different environments (indoor and outdoor) through the deployment of different applications such as geolocalization. In order to favor the portability, designed solutions in EtiPOPS will respect on-going communication standards which will allow a greater interoperability between heterogeneous hardwares.

6.2. France Telecom partnership

Participants: Nathalie Mitton, Enrico Natalizio, Tahiry Razafindralambo [correspondant], Dimitris Zorbas.

This collaboration aims to investigate rural networks and to deploy efficiently and dynamically such networks.

6.3. Noolitic partnership

Participants: Roudy Dagher, Nathalie Mitton [correspondant], Roberto Quilez.

This collaboration aims to set up a localization trial for localization of mobile object in a building based on wireless sensor networks. The idea is to deploy some landmarks (fix sensors) in places to be defined and to equip the mobile objects to other sensors. These sensors must be zigbee compliant for portability purposes.

6.4. Traxens partnership

Participants: Natale Guzzo, Nathalie Mitton [correspondant], Tahiry Razafindralambo.

This collaboration aims to set up a full protocol stack for TRAXENS's guideline.

GANG Project-Team

5. Bilateral Contracts and Grants with Industry

5.1. Bilateral Contracts with Industry

5.1.1. Peer-to-peer for high quality Internet radio

Participant: Fabien Mathieu.

A contract has been signed between Inria, RadioCeros and the ARITT Center. Gang is to provide a feasibility study on the subject of the use of Peer-to-peer mechanisms for high quality Internet radio.

5.1.2. Manipulability of voting systems and applications to networks

Participants: Fabien Mathieu, François Durand.

Alcatel grants ADR LINCS to study applicability of voting systems to loosely connected networks (Peer-to-peer, social networks...).

5.1.3. Extension of PageRank for Social Networks

Participants: Fabien Mathieu, The-Dang Huynh.

ALCATEL is funding a CIFRE PhD for carrying PageRank techniques to Social Networks.

GRAND-LARGE Project-Team (section vide)

HIEPACS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

ASTRIUM Space Transportation research and development contract:

- Design of a parallel version of the FLUSEPA software (Jean-Marie Couteyen (Intership); Jean Roman).

CEA Cadarache (ITER) research and development contract:

- Peta and exaflop algorithms for turbulence simulations of fusion plasmas (Fabien Rozar (PhD); Guillaume Latu, Jean Roman).

EDF R & D - SINETICS research and development contract:

- Design of a massively parallel version of the SN method for neutronic simulations (Moustapha Salli (PhD); Pierre Ramet, Jean Roman).

TOTAL research and development contracts:

- Parallel hybrid solver for massively heterogeneous manycore platforms (Stojce Nakov (PhD); Emmanuel Agullo, Luc Giraud, Abdou Guermouche, Jean Roman).
- Parallel elastodynamic solver for 3D models with local mesh refinement (Yohann Dudouit (PhD); Luc Giraud and Sébastien Pernet from ALGO-EMA at CERFACS).

HIPERCOM Project-Team (section vide)

INDES Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contracts and Grants with Industry

7.1.1. Collaboration with Xiring

In 2011, Tamara Rezk collaborated with a french company based in Paris, Xiring. She visited the company several times in 2011 to carry out this collaboration.

7.1.2. Microsoft Research and Inria Joint Lab

Since 2007, Tamara Rezk is part of the Secure Distributed Computations and their Proofs project of the MSR-Inria lab in Saclay. She travelled several times in 2011 to visit the lab and continue with several collaborations concerning the project.

KERDATA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Microsoft: A-Brain (2010–2013). In the framework of the Joint Inria-Microsoft Research Center. See details in Section 4.1 . To support this project, Microsoft provides 2 million computation hours on the Azure platform and 10 TB of storage per year. The project is funding Louis-Claude Canon as a postdoc fellow (18 months since September 2011) and to complete the PhD MESR grant of Radu Tudoran (*Mission complémentaire d'expertise*, 3 years, started in October 2011).

IBM: MapReduce ANR Project (2010–2014). IBM is a partner of the MapReduce ANR Project: see Section 8.1 .

LOGNET Team

6. Bilateral Contracts and Grants with Industry

6.1. Quantaflow

Participants: Petar Maksimovic [contact], Luigi Liquori, Sebastien Thuriiez [Quantaflow SRL].

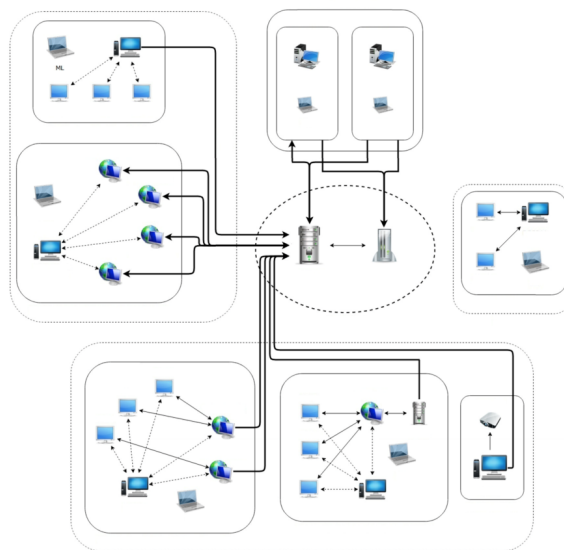


Figure 14. The Quantaflow Network

Quantaflow designs, manufactures and markets hardware, services, and software for professional and autonomous counting and tracking of the flow of people, in the setting of centralized data-gathering, and all for the purposes of security or marketing.

Given the complementarity of their competences, the Parties have decided to form a collaboration in order to formalize a communication protocol that Quantaflow wishes to use with its new equipment.

The main objective of this undertaking was the development of a secure protocol for message exchange between all of the actors in the Quantaflow network see Fig reffig:quantaflow, and has incorporated the following topics:

- Protocol design, in particular:
 - Analysis of use-case scenarios
 - Design of mechanisms for determining device presence in a network
 - Design of protocol messages
 - The flow of protocol messages
- Protocol security, in particular:
 - Message encryption
 - Message authentication
- Cryptography, in particular:
 - Symmetric and public-key cryptography
 - Key storage and management

while the specifics of the work involved are protected by a non-disclosure agreement. This study has been conducted under an NDA and it is released in [24], [25].

6.2. myMed

Participants: Luigi Liquori, myMed Team.

Because of the rich founding of the interreg myMed contract we have started few collaborations under the form of “Contrat de prestations”. Without going too much into détails

- Ludotic: “IHM for myMed”.
- VuLog: info-mobility solutions for myMed (stopped because bad results of the collaboration).
- David Da Silva, “autoentrepreneur”, “conception et implémentation de 3 social application myMed”.
- Sony Marcarelli “ “autoentrepreneur”, “porting of the social applications the Apple Store”.
- GIR MARALPIN: “mounting a critical mass for myMed in the euroregion AlpMed”.

MADYNES Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

As part of our effort in Pervasive Computing research, we worked with Firelies RTLS, a French startup specialized in advanced geolocation services. The contract led to new routing schemes, QoS management protocols for Wireless Sensor Networks.

7.2. Bilateral Grants with Industry

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

MAESTRO Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

MAESTRO members are involved in the INRIA/ALCATEL-LUCENT BELL LABS joint laboratory and participate in several ADRs (Action de Recherche/Research Action). The joint laboratory consists of three ADRs in its first phase (2008–2012) and six ADRs in its second phase (starting October 2012).

6.1.1. ADR “*Semantic Networking*” (January 2008 – April 2013)

Participants: Sara Alouf, Eitan Altman, Konstantin Avrachenkov, Oussama Habachi, Philippe Nain, Marina Sokol.

Coordinators are Isabelle Guérin Lassous (INRIA project-team RESO) for INRIA and Ludovic Noirie for ALCATEL-LUCENT.

The new paradigm of “semantic networking” for the networks of the future brings together “flow-based networking”, “traffic-awareness” and “self-management” concepts to get “plug-and-play” networks. The natural traffic granularity is the flow. MAESTRO’s task is to elaborate on the scheduling of flows in routers having in mind the fairness among flows with different round-trip times. Three joint INRIA/ALCATEL-LUCENT patents have been filed already, one in 2009 (inventors for INRIA: S. Alouf, K. Avrachenkov, D. Carra, P. Nain) and two in 2010 (inventors for INRIA: S. Alouf, K. Avrachenkov, A. Blanc).

6.1.2. ADR “*Self-Organized Networks in Wireless*” (October 2012 –)

Participants: Eitan Altman, Majed Haddad, Manjesh Kumar Hanawal.

Coordinators are Bruno Gaujal (head of INRIA project-team MESCAL) for INRIA and Laurent Roullet for ALCATEL-LUCENT.

This ADR is a follow-up of the ADR “Self Optimizing Wireless Networks” from the first phase. Two joint INRIA/ALCATEL-LUCENT patents have been filed during the first phase, one in 2011 (inventors for INRIA: E. Altman, S. Ramanath) and one in 2012 (inventors for INRIA: E. Altman).

Many key features in mobile access networks rely on user velocity information in order to reinforce the perception of performance stability during mobility. Based on the analytical framework elaborated during the first phase that show the need for an efficient method of user speed estimation, the first objective of the research activity (strongly supported by the Wireless Business Unit) is to devise a procedure for user speed estimation or classification.

6.2. Bilateral Grants with Industry

6.2.1. CRE “*Content-Centric Networking*” (October 2010 – December 2012)

Participants: Sara Alouf, Konstantin Avrachenkov, Nicaise Choungmo Fofack, Philippe Nain, Giovanni Neglia.

Contractor: Orange Labs (<http://www.orange.com/en/innovation>)

Participants: Bruno Kauffmann, Luca Muscariello, Alain Simonian.

The objective of this grant (CRE) is to develop mathematical models for the analysis of Content-Centric Networks (CCN). This research focuses on routing and caching policies.

P. Nain is responsible for INRIA. This work is done in collaboration with C. Barakat (PLANETE, INRIA).

6.2.2. CRE “*Self Optimization in Networks*” (October 2009 – September 2012)

Participants: Eitan Altman, Richard Combes.

Contractors are

- Orange Labs (<http://www.orange.com/en/innovation>). Participant: Zwi Altman,
- Univ. Pierre and Marie Curie (UPMC, <http://www.upmc.fr>). Participant: Sylvain Sorin.

This grant (CRE) from Orange Labs is related to a Cifre thesis allocated to R. Combes, whose advisors are E. Altman, S. Sorin (UPMC) and Z. Altman (Orange Labs).

MASCOTTE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. Contract APRF (région PACA/FEDER) RAISOM with 3-Roam and Avisto, 05/2009 - 04/2012

Participants: Jean-Claude Bermond, David Coudert, Alvinice Kodjo, Stéphane Pérennes, Issam Tahiri.

On Wireless IP Service Deployment optimization and monitoring.

(<http://www-sop.inria.fr/mascotte/projets/raisom/>)

7.2. Bilateral Grants with Industry

7.2.1. Contract CIFRE with Orange Labs, 11/2009 - 12/2012

Participants: Jean-Claude Bermond, Mikaila Toko Worou.

"Convention de recherche encadrant une bourse CIFRE" on the topic *Outils algorithmiques pour la détection des communautés*.

7.2.2. Contract CIFRE with Orange Labs, 02/2011 - 01/2014

Participants: Jean-Claude Bermond, Sébastien Félix.

"Convention de recherche encadrant une bourse CIFRE" on the topic *Smart Transports: optimisation du trafic dans les villes*.

7.2.3. Contract CIFRE with KONTRON, 11/2011 - 10/2014

Participants: Michel Syska, Mohamed Amine Bergach.

"Convention de recherche encadrant une bourse CIFRE" on the topic *Graphic Processing Units for Signal Processing* with joint supervision with AOSTE project.

MESCAL Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contracts with Industry

7.1.1. Real-Time-At-Work

RealTimeAtWork.com is a startup from Inria Lorraine created in December 2007. Bruno Gaujal is a scientific partner and a founding member of the startup. Its main target is to provide software tools for solving real time constraints in embedded systems, particularly for superposition of periodic flows. Such flows are typical in automotive and avionics industries who are the privileged potential users of the technologies developed by <http://www.RealTimeAtWork.com>.

7.1.2. ADR Selfnets with Alcatel

Selfnets is an ADR (action de recherche) of the common laboratory between Inria and Alcatel Lucent Bell Labs. Bruno Gaujal is co-leading the action with Vincent Rocca. Selfnets is mainly concerned with self-optimizing wireless networks (Wifi, 3G, LTE). Eight Inria teams are participating in Selfnets. As for MESCAL, we mainly work on recent mobile equipment (e.g. using the norm IEEE 802.21) can freely switch between different technologies (vertical handover). This allows for some flexibility in resource assignment and, consequently, increases the potential throughput allocated to each user. We develop and analyze fully distributed algorithms based on evolutionary games that exploit the benefits of vertical handover by finding fair and efficient user-network association schemes.

7.2. Grants with Industry

7.2.1. CIFRE contracts with STMicroelectronics

- Kiril Georgiev has done his PhD with STMicroelectronics on distributed file systems and defended in Dec. 2012.

MOAIS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

- Contract with EDF (2010-2013). High performance scientific visualization. Fund 1 postdoc and 1 PhD. Partners: Inria (MOAIS and EVASION), EDF R&D
- HiPeComp, NANO 2008-2012 contract with ST-MicroElectronics. The project HiPeCoMP (High Performance Components for MPSoC) consists in the development an coupling of: on the one hand, wait-free scheduling techniques (pre-partitioning and mapping, on-line work stealing) of component based multimedia applications on MPSoC architectures; and on the other hand, monitoring, debug and performance software tools for the programming of MPSoC with provable performances.
- CEA: Contract with CEA (2012): Europlexus Parallelization with KAAPI. Partners: Inria Rhône-Alpes and CEA Saclay.

MYRIADS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

7.1.1. EDF R&D (2010-2013)

Participants: Stefania Costache, Christine Morin, Nikos Parlavantzas.

In our collaboration with EDF R&D we investigate resource management in virtualized computing platforms in order to efficiently execute distributed applications with stringent time constraints. Our goal is to design a resource management system for private clouds that provides support for different application SLAs while maximizing the resource utilization of the infrastructure. Stefania Costache's PhD work is funded through a CIFRE grant with EDF R&D.

In 2012, we have completed the implementation of Themis prototype and evaluated it with realistic applications provided by EDF R&D and task farming and batch scheduling environments such as Condor and Torque [20], [19].

OASIS Project-Team (section vide)

PHOENIX Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

7.1.1. Integrating non-functional properties in a Design Language and its execution environment – Industrial Fellowship (CIFRE / Thales)

Participants: Charles Consel, Emilie Balland, Stéphanie Gatti, Quentin Enard.

The goal of this project is to add non-functional properties in the DIASPEC language and in the DIAGEN generator. More especially, these non-functional properties are considered on three different levels:

- *The component level.* The non-functional properties define temporal, physical and software constraints restrictive for a component.
- *The component coupling level.* The non-functional properties define the dependency between the components as well as the Quality of Service provided and required by each component of the environment.
- *The software architecture level.* The non-functional properties describe the resources that must be allocated to a component (memory, processing capacity). They also define the necessary resources for a component to interact with other components (network QoS).

This work will be illustrated and validated with a concrete application in the avionics domain.

PLANETE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contracts with Industry

Industrial contract with Alcatel Lucent - Bell Labs (2008-2012):

The goal of this study is the use of AL-FEC techniques in broadcasting systems and in particular on the optimization of FEC strategies for wireless communications. Two persons are working in the context of this contract: Ferdaouss Mattoussi works on the design, analysis and optimization of a Generalized LDPC AL-FEC scheme, and Rodrigue Imad work focuses on Unequal Erasure Protection capabilities (UEP) and file bundle protection systems.

RAP Project-Team

5. Bilateral Contracts and Grants with Industry

5.1. Contracts

- CRE with Orange Labs “ Dynamical Optical Networking in the Internet”. Contract on bandwidth allocation algorithm in optical networks. Duration 2 years starting from 01/01/12.
- CELTIC-Plus Saser “Safe and Secure European Routing” submitted. RAP participates in the section on optical networks. Participants include Orange labs, Alcatel-Lucent, Telecom Institute, ENSSAT as well as a number of German laboratories. Duration three years.
- ANR Project “CONNECT: Content-Oriented Networking: a New Experience for Content Transfer”. The proposal submitted to the VERSO programme has been accepted. The planned starting date is January 2011 and the project is scheduled to last 2 years. The lead partner is Alcatel-Lucent Bell Labs France and the other partners are RAP, Inria/PLANETE, Orange LABs, TelecomParisTech, UPMC.
- The ANR Boole contract (Models for random Boolean functions and applications) has been transferred from the Algorithms project, and the funding will last until August 2013.
- PhD grant CJS (Contrat Jeune Scientifique) Frontières du vivant of INRA for Emanuele Leoncini.

5.2. Bilateral Grants

- A bilateral project PHC Tournesol funded by Campus France (formerly Egide) will cover the costs of exchanges between *Nicolas Broutin* and Stefan Langerman (FNRS, UL Brussels). The topic of the collaboration is coloration of random hypergraphs for channel assignment in networks.

REGAL Project-Team (section vide)

RMOD Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Resilience FUI

Participants: Nicolas Petton [Correspondant], Stéphane Ducasse, Damien Cassou.

Contracting parties: Nexedi, Morphom Alcatel-Lucent Bell Labs, Astrium Geo Information, Wallix, XWiki, Alixen, Alterway, Institut Télécom, Université Paris 13, CEA LIST.

Resilience's goal is to protect private data on the cloud, to reduce spying and data loss in case of natural problems. Resilience propose to develop a decentralized cloud architecture: SafeOS. Safe OS is based on replication of servers. In addition a safe solution for documents should be developed. Sandboxing for Javascript applications should be explored.

There is a plethora of research articles describing the deep semantics of JavaScript. Nevertheless, such articles are often difficult to grasp for readers not familiar with formal semantics. In our first report, we propose a digest of the semantics of JavaScript centered around security concerns. This report proposes an overview of the JavaScript language and the misleading semantic points in its design. The first part of the report describes the main characteristics of the language itself. The second part presents how those characteristics can lead to problems. The document finishes by showing some coding patterns to avoid certain traps and presents some ECMAScript 5 new features.

6.2. Generali Belgium

Participants: Nicolas Anquetil [Correspondant], Stéphane Ducasse, Guillaume Larcheveque, Muhammad Bhatti, Camille Teruel.

Contracting parties:

Synectique our startup company project;

Generali Assurances <http://www.generali.be>.

RMoD is looking into providing a software solution to Generali Belgium for its software maintenance and reengineering problems. The goal is to support decision making in a software migration project. The partner needs tools for parsing their legacy code (in a specific, not well-known language) and help in identifying dead code or code duplication. This should serve as an essential element of decision support in the partner's software migration project.

The contract is worth 30.000€.

6.3. Pharo Consortium

We launched the Pharo Consortium. Over 25 companies are interested in participating. Inria supports the consortium with one full time engineer starting in 2011.

ROMA Team (section vide)

RUNTIME Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

SAMSUNG We have signed a contract with the Samsung company to work on the *Generation of Parallel Patterns based programs for hybrid CPU-GPU architectures* from october 2012 to september 2013.

7.2. Bilateral Grants with Industry

STMicroelectronics STMicroelectronics is granting the CIFRE PhD Thesis of Paul-Antoine Arras on *The development of a flexible heterogeneous system-on-chip platform using a mix of programmable processing elements and hardware accelerators* from October 2011 to October 2014.

TOTAL TOTAL is granting the CIFRE PhD thesis of Corentin Rossignon on *Sparse GMRES on heterogeneous platforms in oil extraction simulation* from april 2012 to march 2015.

CEA-CESTA CEA-CESTA is granting the CIFRE PhD thesis of Cyril Bordage on *Parallelization of fast multipole methods over hybrid CPU+GPU architectures* from october 2009 to november 2012.

SARDES Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Grants with Industry

- PhD grant Quentin Sabah, funded by STMicroelectronics.
- PhD grant Xavier Etchevers, funded by Orange Labs.

SCORE Team (section vide)

SOCRATE Team

7. Bilateral Contracts and Grants with Industry

7.1. Industry

Socrate has strong collaboration with Orange Labs (point to point collaboration) and Alcatel Lucent through the Inria-ALU common lab and the Green Touch initiative. Socrate also works in collaboration with Siradel, a french worldwide company working on wireless system simulations, Sigfox a french young compagny deploying the first cellular network operator dedicated to M2M and IoT, and HIKOB a start-up originated from the Citi laboratory providing sensor networks solutions. A bilateral cooperation supports the PhD of Laurent Maviel, and Siradel is a member of the Ecoscell ANR project in which Socrate is involved.

Socrate started in September 2011 a strong bilateral cooperation with the Euromedia group about Body Area Networks in which Hervé Parvery, Guillaume Villemaud and Jean-Marie Gorce are involved and the project supports the thesis of Matthieu Lauzier.

7.2. National Actions

7.2.1. Equipex FIT- Future Internet of Things (2011-..., 1.064 k€)

The FIT projet is a national equipex (*équipement d'excellence*), headed by the Lip6 laboratory. As a member of Inria, Socrate is in charge of the development of an Experimental Cognitive Radio platform that should be used as test-bed for SDR terminals and cognitive radio experiments. This should be operational in 2013 for a duration of 7 years. To give a quick view, the user will have a way to configure and program through Internet several SDR platforms (MIMO, SISO, and baseband processing nodes).

7.2.2. ANR - ECOSCELLS - Efficient Cooperating Small Cells (2009-2012, 242 keuros)

Ecoscells is a national initiative (ANR) which aims at developing algorithms and solutions to ease Small Cells Network deployment. Theoretical studies will provide models for understanding the impact of radio channels, and permit the definition of new algorithms exploiting a full diversity (user, spatial, interferences, etc.) of such networks. The novelty of the project is not to consider the interference as a drawback anymore, but to exploit it in order to offer an optimal resource utilization. The algorithms will be based on most recent developments in distributed algorithms, game theory, reinforcement learning. Architecture and algorithms for the back-hauling network will also be proposed.

7.2.3. ANR - Cormoran - "Cooperative and Mobile Wireless Body Area Networks for Group Navigation" (2012-2015, 150 keuros)

Cormoran project targets to figure out innovative communication functionalities and radiolocation algorithms that could benefit from inter/intra-BAN cooperation. More precisely, the idea is to enable accurate nodes/body location, as well as Quality of Service management and communications reliability (from the protocol point of view), while coping with inter-BAN coexistence, low power constraints and complying with the IEEE 802.15.6 standard. The proposed solutions will be evaluated in realistic applicative scenarios, hence necessitating the development of adapted simulation tools and real-life experiments based on hardware platforms. For this sake, Cormoran will follow an original approach, mixing theoretical work (e.g. modelling activities, algorithms and cross-layer PHY/MAC/NWK design) with more practical aspects (e.g. channel and antennas measurement campaigns, algorithms interfacing with real platforms, demonstrations).

7.2.4. FUI ECONHOME - “Energy efficient home networking” (2010-2014, 309 keuros)

The project aims at reducing the energy consumption of the home (multimedia) data networks, while maintaining the quality requirements for heterogeneous services and flows, and preserving, or even enhancing the overall system performance. The equipments under concern are residential gateways, set-top-boxes, PLC modules, Wifi extenders, NAS. The user equipment, such as smartphones, tablets or PCs are not concerned. The approach relies on combining both individual equipments IC and system level protocols that have to be eco-designed.

7.2.5. ADR Selfnet - “Self Optimization Networking” (2008-2012, 258 keuros)

This action is a part of the common lab of Inria and Alcatel Lucent Bell Labs. This action groups several team of Inria with Alcatel teams and addresses different aspects of Self Networking: distributed algorithms, energy efficiency, mobility. Virgile Garcia has finished his PhD on distributed power management in cellular networks and

7.3. Actions Funded by the EC

7.3.1. Projet iPLAN - FP7-PEOPLE-IAPP-2008 (2009-2012, 440 keuros)

(Indoor Planning) (2009-2012, 440k€)

iPlan is an FP7 project of the FP7-People-IAPP-2008 call. The iPlan consortium is made of the Ranplan Company, the Citi Laboratory and the University of Bedfordshire and proposes the study of Indoor planning and optimization models and tools. The aim is to develop fast and accurate radio propagation models, investigate various issues arising from the use of femtocells, develop an automatic indoor radio network planning and optimization and facilitate knowledge integration and transfer between project partners, to enable cross-fertilization between radio propagation modeling, wireless communications, operations research, computing, and software engineering.

7.4. Theses, Internships

7.4.1. Theses

7.4.1.1. Theses defended in 2012

Virgile Garcia: “Resource sharing optimisation for self-organized cellular networks”, PhD thesis from INSA LYON, Inria/Alcatel-Lucent grant, 30/04/2012.

7.4.1.2. Theses in preparation

Mickael Dardaillon: “Virtual machine for the cognitive radio”, Rhône-Alpes grant, since 10/2011.

Cengiz Hasan: “Optimization of resource allocation for small cells networks”, Orange labs grant, since 01/2010.

Paul Ferrand: “Cooperative communications in BANET”, MENRT, since 10/2009.

Arturo Jimenez Guizar: “Cooperative communications in Body Area Networks”, ANR Cormoran grant, since 09/2012.

Matthieu Lauzier: “Design and evaluation of information gathering systems for dense mobile wireless sensor networks”, CIFRE/Euromedia, since 09/2011.

Meiling Luo: “Fast and accurate radio propagation models for radio network planning”, MENRT grant, since 01/2010.

Laurent Maviel: “Wireless heterogeneous networks dynamic planning in urban and indoor non-stationary environments”, CIFRE grant with SIRADEL, since 11/2009.

Baher Mawlawi: CEA grant, since 09/2012.

Matthieu Vallerian: “Radio Logicielle pour réseau de capteurs”, CIFRE/Orange, since 09/2012.

Zhaowu Zhan: “Full-Duplex Multimode MIMO wireless communications”, CSC/China grant with , since 9/2012.

7.4.2. Participation in thesis Committees

Jean-Marie Gorce:

- Examineur au jury d’Habilitation à diriger les recherches de Olivier Berder: “Systèmes multi-antennes et efficacité énergétique des réseaux de capteurs sans fil” (nov. 2012, Univ. Rennes1)
- Examineur au jury d’Habilitation à diriger les recherches de Fabien Mieyeville: “Méthodes de conception hiérarchique de systèmes hétérogènes multi-physiques communicants” (Ecole Centrale Lyon, mai. 2012)
- Rapporteur de la thèse de Guillaume Viennot “Utilisation de techniques d’imagerie de synthèse pour le calcul de la propagation des champs électromagnétiques” (Université Limoges, dec. 2012)
- Rapporteur de la thèse de Hussein Kdouh: “Application of Wireless Technologies to Alarm and Monitoring System on Board Ships” (INSA Rennes, dec. 2012).
- Rapporteur de la thèse de Vinh Tran: “Energy efficient cooperative relay protocols for wireless sensor networks” (Université Rennes 1, dec. 2012).
- Rapporteur de la thèse de Mustapha Dakkak: “Indoor geo-location : static and dynamic geo-location of mobile terminals in Indoor environments” (Université Paris-Est, nov. 2012).
- Rapporteur de la thèse de Yougourta Benfattoum: “Network coding for quality of service in wireless multi-hop networks” (Université Paris-Sud, nov. 2012).
- Rapporteur de la thèse de Getachew Rediateb: “Cross-layer optimization for next generation WiFi” (INSA Rennes, oct. 2012).
- Rapporteur de la thèse de Dora Ben Cheikh Battikh “Outage probability formulas for cellular networks: contributions for MIMO, CoMP and time reversal features” (Telecoms Paris Tech, juillet 2012).
- Directeur de thèse de Virgile Garcia: “Opportunistic radio resource sharing for next-gen cellular networks” (Insa-Lyon, 29 Mars 212).

Tanguy Risset:

- Président de jury de la thèse d’Antoine Floch, le 8 juin 2012 (U. Rennes 1/ENS Cachan)
- Examineur pour le jury de thèse de Naeem Abbas, 22 mai 2012 (U. Rennes 1/ENS Cachan - IRISA).
- Directeur d’Habilitation à Diriger les recherches de Marine Minier, le 31 mai 2012 (U Lyon1/Insa-Lyon)

7.4.3. Internships

- Pierre BRUNISHOLZ, “OFDM decoding on a Virtex 6 FPGA”
- Fayçal AIT-AOUDIA “OFDM decoding on a Virtex 6 FPGA”
- Moemen CHERNI “Smart radio pour réseau de capteurs”
- Borja DE RIVA SOLLA “Etude des techniques de sous-échantillonnage pour la radio logicielle”
- Thibaut VUILLEMIN “Performance analysis for /dev/random”
- Egea Pierrick “Mise en place d’une plateforme expérimentale d’évolution de charges dans les systèmes d’exploitation”
- Jimenez-Guzar Arturo “PHY layer network coding”
- Richelmy Marion “Algorithmes pour les self-optimized networks”
- Vasselin Virginie “Algorithmes pour les self-optimised networks”

7.5. Teaching

- Tanguy Risset and Jean-Marie Gorce are professor in the Telecommunications department of Insa Lyon.
- Claire Goursaud is associate professor in the Telecommunications department of Insa Lyon.
- Guillaume Salagnac and Kevin Marquet are associate professors in the Computer Science department of Insa Lyon.
- Guillaume Villemaud and Florin Hutu are associate professor in the Electrical Engineering department of Insa Lyon.
- Nikolai Lebedev is associate professor in the engineering school in Chemistry, Physics and Electronics, Lyon.
- Tanguy Risset has been the vice-head of the Telecommunications department of Insa Lyon until september 2012.
- Tanguy Risset is the responsible for the Networking program of the Master Mastria from University of Lyon.
- Jean-Marie Gorce is the responsible for the Telecommunications program of the future Master EEAP from University of Lyon.
- Guillaume Villemaud is responsible for international relations in the Electrical engineering département of Insa Lyon

TREC Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Laboratoire Commun Alcatel-lucent Bell Labs / Inria

Participant: Anne Bouillard.

The joint laboratory was launched on 2008. The objective of this collaboration is to contribute to the autonomic networking trend. On Inria's side, the research for this ADR (*action de recherche*) is mainly located at DISTRIBCOM team-project. On TREC's side, it involves the co-supervision of the thesis of Aurore Junier and has led to one publication [30] and a patent application [57].

7.2. CIFRE Grant of Technicolor

Participants: Mathieu Leconte, Marc Lelarge, Laurent Massoulié.

The CIFRE grant of Mathieu started in January 2011. The topic bears on information dissemination and recommendation in social networks. The distribution of multimedia content and the use of social networks like Facebook, Orkut, etc. are booming in today's networks. These social networks are also increasingly used for dissemination and recommendation of content. The objective of the thesis will be to develop an understanding of how information disseminates in social networks based on the type of information, user tastes, and the topological structure of these networks. This study will result in developing methods for more effective dissemination of content.

7.3. CIFRE Grant of Orange

Participants: Bartłomiej Błaszczyszyn, Miodrag Jovanović.

The CIFRE grant of Miodrag started in 2012. The topic bears on the evaluation and optimization of the QoS for new services in cellular networks. This year a work on feasible bit-rates in the MIMO LTE (Long Term Evolution) cellular networks has been presented in [39]. We have been also studying real-time streaming (like mobile TV) in wireless cellular networks. This work is reported in [50] submitted for the publication.

TRISKELL Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. VaryMDE

Participants: Benoit Combemale, Olivier Barais, Mathieu Acher, Jean-Marc Jézéquel, Joao Ferreira filho, Suresh Pillay.

MDE, Variability Management, Software Language Engineering.

This bilateral collaboration is between the Triskell team and the MDE lab at Thales Research & Technology. This partnership explores variability management both in modeling and metamodeling (i.e., design and implementation of software languages), and enrolls 4 faculty members and 2 PhD students from the Triskell team. This year, we keep working on the CVL usage in the Thales context.

Project duration: 2011-2014

Triskell budget share: 284 keuros

7.2. EDF

Participants: Nicolas Sannier, Benoit Baudry.

model-driven analysis, requirements modelling, evolution

Since October 2010, we have a collaboration with EDF R& D, Chatou. This project aims at investigating the application of metamodeling and model-driven engineering for modeling and analyzing requirement documents of control-command systems. The purpose of this modeling activity is to improve the global understanding of dependencies between requirements and their context and to use this knowledge for impact analysis in case of evolution. In this context, Benoit Baudry acts as Ph.D advisor for Nicolas Sannier.

Project duration: 2010-2013

Triskell budget share: 30 keuros

7.3. Kereval

Participants: Aymeric Hervieu, Benoit Baudry.

test generation, software product lines, test reuse

Since October 2010, we have a collaboration with Kereval, an SME specialized in software testing. In this project we investigate the selection and reuse of test cases for software product lines in the automotive domain. In this context, Benoit Baudry acts as Ph.D advisor for Aymeric Hervieu. Arnaud Gotlieb from the Celtique EPI acts as a co-advisor for the PhD, as well as Olivier Philippot from Kereval.

Project duration: 2010-2013

Triskell budget share: 15 keuros

7.4. Sodifrance

Participants: Emmanuelle Rouillé, Benoit Combemale, Olivier Barais, Jean-Marc Jézéquel.

Software Process, Intentional-Driven Development, Process Execution

Since October 2010, we have a collaboration with Sodifrance, Rennes. In this project we investigate the support (capitalization, definition, execution, and adaptation) of software processes in the context of model driven development (MDD). The purpose of this work is twofold:

- automate the tool configuration and the dynamic adaptation of MDD CASE tools.
- support an automated verification of models, according to the requirements for each activity of the process.

In this context, Jean-Marc Jézéquel acts as Ph.D advisor for Emmanuelle Rouillé, also supervised by Benoit Combemale and Olivier Barais.

Project duration: 2010-2013

Triskell budget share: 25 keuros

7.5. All4Tec

Participants: Hamza Sahmi, Benoit Baudry.

Model-based testing, Software product lines

In this project with the All4Tec company we investigate the support of variability modelling for model-based test generation with Matelo (a tool developed by All4Tec).

In this context, Benoit Baudry acts as Ph.D advisor for Hamza Samih.

Project duration: 2011-2014

Triskell budget share: 20 keuros

7.6. Zenexity

Participants: Julien Richard-FOY, Olivier Barais, Jean-Marc Jezequel.

Web engineering, Domain Specific Languages

In this project with the Zenexity company we investigate the new architecture model for efficient web development on top of the play framework (a web framework developed by Zenexity).

In this context, Jean-Marc Jézéquel and Olivier Barais act as Ph.D advisor for Julien Richard Foy.

Project duration: 2011-2014

Triskell budget share: 20 keuros

URBANET Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Two bilateral collaborations are running since 2009 with Orange Labs, and another one since 2008. These collaborations include the supervision of Ph.D. students into a common research program (heterogeneity in wireless sensor networks, resiliency and security of routing protocols, quality of service support of WSN). These three collaborations ended in 2012.
- Two short-term bilateral collaborations, also with Orange Labs, were pursued in 2012: a 4 months project in quality of service in WSN (joint supervision of a master student), and a 2 months project on the SensORLab testbed, deployed in Orange Labs (Meylan).
- A new bilateral collaboration with Orange started in November 2012. This CRE includes the supervision of a CIFRE thesis about multi-topology routing protocol and service level agreement for wireless sensor networks.
- One short-term bilateral collaborations with Thalès was done during 4 months, as a preliminary research project for a Ph.D. student. Unfortunately, no candidate with solid/strong background applied for this position yet. This project should start in 2013.

ALICE Project-Team (section vide)

ALPAGE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contracts with Industry

Alpage has developed several collaborations with industrial partners. Apart from grants described in the next section, specific collaboration agreements have been set up with Verbatim Analysis (license agreement and “CIFRE” PhD, see section 4.3), Lingua et Machina (DTI-funded engineer, see section 4.4), Viavoo, and Diadeis (the “Investissements d’Avenir” project PACTE has started in 2012, see section 4.5).

AVIZ Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Google Research Award

Participants: Jean-Daniel Fekete [correspondant], Petra Isenberg, Jeremy Boy, Heidi Lam.

Offering data access to the public is a strong trend of the recent years. Several free data providers or repositories are now online (e.g. <http://data.gov.uk>, <http://stats.oecd.org>, <http://publicdata.eu>, <http://opendata.paris.fr>, <http://www.google.com/publicdata>, <http://www.data-publica.com>), offering a rich set of data to allow citizens to build their own understanding of complex political and economic information by exploring information in its original form. However, these initiatives have had little impact directly on the public since working with this open data is often cumbersome, requires additional data wrangling, and the spreadsheets themselves take a long time to understand before useful further work can be done with them. This proposal focuses on public data visualization to offer more engaging environments for exploration of public data and to enable stronger democratic discourse about the data contents.

The goal of this proposed research project is to bridge the gap between generic visualization sites for public data and engaging content-specific visualization of this data which can be used and individually adapted to tell a story about public data. Through the design and deployment of rich and engaging interactive visualizations from public data sources we want to truly reach the goal of the public data movement: empowering the citizens and social actors by allowing them to better understand the world they are living in, to make informed decisions on complex issues such as the impact of a medical treatment on a dangerous illness or the tradeoffs offered of power plant technologies based on facts instead of assumptions.

For more information, see <http://peopleviz.gforge.inria.fr/www>.

AXIS Project-Team (section vide)

AYIN Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts and Grants with Industry

7.1.1. Galderma Sophia-Antipolis

Participants: Sylvain Prigent, Xavier Descombes [Morpheme PI], Josiane Zerubia [AYIN PI].

Contribution of multi and hyperspectral imaging to skin pigmentation evaluation. Contract #4383.

7.1.2. ISA/DITEN

Participants: Aurélie Voisin, Vladimir Krylov, Josiane Zerubia [AYIN PI].

Development and validation of multitemporal image analysis methodologies for multirisk monitoring of critical structures and infrastructures. In collaboration with Gabriele Moser and Sebastiano Serpico[PI], from the University of Genoa (DITEN) and the Italian Space Agency (ISA).

7.1.3. EADS foundation

Participants: Ikhlef Bechar, Josiane Zerubia [PI].

Detection of objects in infrared imagery using phase field higher-order active contours. In collaboration with Ian Jermyn from the University of Durham (Dept of Mathematical Sciences).

7.1.4. Astrium/EADS

Participants: Paula Craciun, Josiane Zerubia [PI].

Automatic object tracking on a sequence of images taken from a geostationary satellite. In collaboration with Pierre Del Moral from Inria Bordeaux (ALEA team) and Ecole Polytechnique (CMAPX) Palaiseau.

COPRIN Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Airbus France

Participant: Yves Papegay.

To improve the production of numerical (flight) simulators from models of aerodynamics, Airbus France is interested in methods and tools like those described in 6.3.1 .

Following the contracts signed in 2003, 2005 and 2007 with the aircraft maker, and a consulting contract in 2008 to study the possible development of an industrial tool, we have initiated in 2009 a 2-years collaboration (extended in 2012) to enhanced the fonctionnalities and performances of the existing pieces of software belonging to Airbus and to turn them into a prototype that integrate and showcase our results.

Following a first transfer agreement signed in 2010, and another contract licensing to Airbus a second version of this prototype in 2011, a last agreement to be signed in November 2012 will license the final and tested version [34].

7.2. Thales Alenia Space

Participants: David Daney [correspondant], Thibault Gayral, Jean-Pierre Merlet.

Thales Alenia Space, in partnership with the Coprin team, is studying a new concept of active space telescope. Based on a parallel architecture, its structure allows not only the telescope deployment in space but also the accurate positioning of the secondary mirror with respect to the primary one in order to improve the provided images quality. The deployment and re-positioning concepts were validated thanks to a first prototype, and the telescope performances improvement is currently under study. A first study brought to light the front-seat role of mechanical joints on the structure accuracy. However, in order to deal with the required optical accuracy and space constraints, those mechanical joints had to be replaced by flexible ones. A new prototype was then designed and built in order to validate its ability to ameliorate its images quality using flexible joints. The goal of this project is to self-calibrate the mechanical structure of the telescope: using only proprioceptive information, parameters of the robot model will be identified. Thus, a space telescope based on this concept will be able to reach its final orbit, and then to improve its image accuracy thanks to an autonomous procedure.

7.3. Collaboration with ADEME: carbon value and carbon tax in the context of renewable energies deployment

Participants: Odile Pourtallier, Mireille Bossy.

Started in January 2009 and finished in October 2012, this collaboration financed by the French Environment and Energy Management Agency (ADEME), involves the Centre for Applied Mathematics (CMA), at Mines ParisTech, COPRIN and TOSCA teams at Inria. It focuses on a short term carbon value derived from the so-called financial *carbon market*, the European Union Emission Trading Scheme (EU ETS), which is a framework for GHG emissions reduction in European industry.

The objective of this project is to study the compatibility and complementarity of a carbon tax and a target for renewable energy deployment [32], see also Inria -TOSCA Team report.

DAHU Project-Team (section vide)

DREAM Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

7.1.1. *ManageYourSelf: diagnosis and monitoring of embedded platforms*

Participants: Marie-Odile Cordier, Sophie Robin, Laurence Rozé.

ManageYourSelf is a project that deals with the diagnosis and monitoring of embedded platforms, in the framework of a collaboration with Telelogos, a French company expert in mobile management and data synchronization. ManageYourSelf aims to perform diagnostic and repair on a fleet of mobile smartphones and PDAs. The idea is to embed on the mobile devices a rule-based expert system and its set of politics, for example "if memory full 'then delete (directory). recognition is performed, using the parameters of the phones as the fact base. Of course, it is impossible to foresee all the rules in advance. Upon detection of a non anticipated problem, a report containing all the system's information prior to the problem is sent to a server. The learning step was first implemented using using decision trees, the aim being to characterize the faults and consequently update the global knowledge base and its distributed instances. This year, we studied an incremental version of this learning step in order to get an on-line process [20]. This means being able to learn new faults characterizations and add new preventive rules, and also forget no longer needed ones.

7.2. National Initiatives

7.2.1. *SACADEAU-APPEAU: Decision-aid to improve streamwater quality*

Participants: Marie-Odile Cordier, Véronique Masson.

The SACADEAU project (Système d'Acquisition de Connaissances pour l'Aide à la Décision pour la qualité de l'EAU - Knowledge Acquisition System for Decision-Aid to Improve Streamwater Quality) was funded by INRA (French institute for agronomy research) from October 2002 to October 2005. The main partners were from INRA (SAS from Rennes and BIA from Toulouse) and from IRISA.

We were then involved in a new project, named APPEAU and funded by ANR/ADD, which started in February 2007 and ended in december 2011. The APPEAU project aimed at studying which politics, for which agronomic systems, are best adapted to improve water management. It includes our previous partners as well as new ones, mainly from INRA(http://www.agir.toulouse.inra.fr/agir/index.php?option=com_content&view=article&id=62&Itemid=134). A synthesis paper has been published in 2012 [5].

7.2.2. *ACASSYA: Supporting the agro ecological evolution of breeding systems in coastal watersheds*

Participants: Marie-Odile Cordier, Véronique Masson, René Quiniou.

The ACASSYA project (ACcompagner l'évolution Agro-écologique deS SYstèmes d'élevage dans les bassins versants côtiers) is funded by ANR/ADD. It started at the beginning of 2009 and will end in june 2013. The main partners are our colleagues from INRA (SAS from Rennes. One of the objectives is to develop modeling tools supporting the management of ecosystems, and more precisely the agro ecological evolution of breeding systems in coastal watersheds. In this context, the challenge is to transform existing simulation tools (as SACADEAU or TNT2 into decision-aid tools, able to answer queries or scenarios about the future evolution of ecosystems. (http://www.rennes.inra.fr/umrsas/programmes/acassya_accompagner_l_evolution_agro_ecologique_des_systemes_d_elevage))

7.2.3. PayOTE-Network: characterizing agricultural landscapes via data mining

Participants: Thomas Guyet, René Quiniou.

The PAYOTE project (Paysage Ou Territoire) was initially funded by AIP INRA/INRIA. It started at the end of 2010 and will end by the end of 2012.. The project is turning into a network mainly funded by INRA. This network still associates Inria Teams (Orpailleur and Dream) with INRA Team (UBIA, MIAJ and SAD-Paysage).

One of the objectives of the PAYOTE network is to provide tools to generate “realistic” agricultural landscapes. This kind of generator are expected by expert to study the impact of the landscape on agro-ecological systems. The main approach of this network is to use data mining to automatically construct a neutral model of a landscape. Then, the model of a landscape may be used to generate new landscapes with same spatial properties.

In this context, the challenge is to develop spatio-temporal data mining algorithms to analyse the spatial organization of agricultural landscapes.

E-MOTION Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Contracts with Industry

6.1.1. Toyota Motors Europe

[Feb 2006 - Feb 2009] [Dec 2010 - Dec 2014]

The contract with Toyota Motors Europe is a joint collaboration involving Toyota Motors Europe, Inria and ProBayes. It follows a first successful short term collaboration with Toyota in 2005.

This contract aims at developing innovative technologies in the context of automotive safety. The idea is to improve road safety in driving situations by equipping vehicles with the technology to model on the fly the dynamic environment, to sense and identify potentially dangerous traffic participants or road obstacles, and to evaluate the collision risk. The sensing is performed using sensors commonly used in automotive applications such as cameras and lidar.

This collaboration has been extended for 4 years and Toyota provides us with an experimental vehicle Lexus equipped with various sensing and control capabilities. Several additional connected technical contracts have been signed also.

6.1.2. Renault

[Jan 2010 - Feb 2013]

This contract is linked to the PhD Thesis of Stephanie Lefèvre. The objective is to develop technologies for collaborative driving as part of a Driving Assistance Systems for improving car safety. Both vehicle perception and communications are considered in the scope of this study. An additional short-term contract (3 months) has also been signed in november 2012.

6.1.3. PROTEUS

[November 2009 - October 2013]

PROTEUS (“Robotic Platform to facilitate transfer between Industries and academics”) is an ANR project involving 6 industrial and 7 academic partners. This projects aims to develop a software platform which helps to share methods and softwares between academics and industries in the field of mobile robotics.

The project works on three main aspects :

- Specification of different scenarios and its associated formalism.
- Definition of a domain specific language (DSL) to specify and execute the given scenarios.
- Setting up 4 robotic challenges to evaluate the capacity and the usability of the platform.

The contribution of *e-Motion* to PROTEUS is first to provide its expertise on mobile robotics to develop the DSL and next to provide a simulation environment with its platform “CycabTK”.

Juan Lahera-Perez has been recruited as engineer to work on this project with Amaury Nègre.

6.1.4. Delta Drone

[9 May 2012 - 9 November 2012]

This is a collaboration between our lab and the company Delta Drone. The goal of this collaboration is the exploitation of our competences in visual inertial navigation in order to make a drone able to perform autonomous navigation in GPS denied environment. This would have a strong impact on many civilian applications (e.g., surveillance, rescue mission, building inspection, etc.) During 2012, our effort has been focused on the first important step which must be accomplished in order to perform any task: the hovering. To this regard, we introduced a new method to localize a micro aerial vehicle (MAV) in GPS denied environments and without the usage of any known pattern. This makes possible to perform hovering in an unknown and GPS denied environment. The method has successfully been implemented on the platform available in our lab. This is a *Pelican* from *Ascending Technologies* equipped with an Intel Atom processor board (1.6 GHz, 1 GB RAM).

6.1.5. IRT-Nano Perfect (2012-2014, and 2015-2017)

Perfect is a project supported by ANR in the scope of the IRT (Technological Research Institute) Nano-electronic driven by the CEA (Nuclear Energy Agency). The partners of the project are the CEA-LETI LIALP laboratory, ST-Microelectronics and Inria. The goal of this project is to propose integrated solutions for “Embedded Bayesian Perception for dynamic environments” and to develop integrated open platforms. During the first phase of the project (2012-2014), the focus is on the domain of transportation (both vehicle and infrastructure); health and smart home sectors will also be considered in the second phase (2015-2017).

6.1.6. FUI Permobilier (2013-2015) – submitted

Permobilier is a project submitted to the 15th FUI call for project. The consortium of the project puts together research labs, large industrial partners and local small and medium companies. The objective of Permobilier is to create electronic solutions (both hardware and software) for an embedded system for mobile perception in dynamic environments. This system is intended to anticipate potential collisions which may occur for the mobile platform (car, bus, aerial drone. . .).

The starting point is the current perception system developed in the e-Motion team for automotive applications, which is currently implemented on a standard PC (CPU+GPU) architecture. Permobilier intends to improve the perception capability and to reduce the size, cost and electrical consumption of the system through the integration on the mobile technologies. A first stage consists in using current mobile technologies, while the second stage proposes to develop an innovative mobile board incorporating multiple mobile CPU/GPU processors. Demonstrators based on real mobile platforms (bus and aerial drone) will be developed to assess the realism and the efficiency of the approach developed in the project.

The partners of the project include both experts in software (Inria, Probayes), hardware (CEA LETI, Calao systems, ST-Ericsson), and final users of the technology (Delta-Drone, SEMITAG).

6.2. National Initiatives

6.2.1. Inria Large Initiative Scale PAL (Personally Assisted Living

[Nov 2009 - Nov 2013]

The objective of this project is to create a research infrastructure that will enable experiments with technologies for improving the quality of life for persons who have suffered a loss of autonomy through age, illness or accident. In particular, the project seeks to enable development of technologies that can provide services for elderly and fragile persons, as well as their immediate family, caregivers and social groups.

The Inria Project-Teams (IPT) participating in this Large-scale initiative action Personally Assisted Living (LSIA Pal) propose to work together to develop technologies and services to improve the autonomy and quality of life for elderly and fragile persons. Most of the associated project groups already address issues related to enhancing autonomy and quality of life within their work programs. This goal of this program is to unite these groups around an experimental infrastructure, designed to enable collaborative experimentation.

Working with elderly and fragile to develop new technologies currently poses a number of difficult challenges for Inria research groups. Firstly, elderly people cannot be classified as a single homogeneous group with a single behavior. Their disabilities may be classified as not just physical or cognitive, motor or sensory, but can also be classified as either chronic or temporary. Moreover, this population is unaccustomed to new technologies, and can suffer from both cognitive and social inhibitions when confronted with new technologies. None-the-less, progress in this area has enormous potential for social and financial impact for both the beneficiaries and their immediate family circle.

The spectrum of possible actions in the field of elderly assistance is large. We propose to focus on challenges that have been determined through meetings with field experts (medical experts, public health responsible, sociologists, user associations...). We have grouped these challenges into four themes: monitoring services, mobility aids, transfer and medical rehabilitation, social interaction services. These themes correspond to the scientific projects and expectations of associated Inria projects. The safety of people, restoring their functions in daily life and promoting social cohesion are all core motivations for this initiative.

e-Motion concentrates his work on mobility aids using the wheelchair.

6.3. European Initiatives

6.3.1. Major European Organizations with which you have followed Collaborations

Department of Electrical & Computer Engineering: Univeristy of Thrace, Xanthi (GREECE)

Subject: 3D coverage based on Stochastic Optimization algorithms

BlueBotics: BlueBotics Company, Lausanne (Switzerland)

Subject: Implementation of self-calibration strategies for wheeled robots and SLAM algorithms for industrial purposes

Autonomous System laboratory: ETHZ, Zurich (Switzerland)

Subject: Vision and IMU data Fusion for 3D navigation in GPS denied environment.

6.4. International Initiatives

6.4.1. “ict-PAMM”

[September 2011- September 2013]

ict-PAMM is an ICT-ASIA project accepted in 2011 for 2 years. It is funded by the French Ministry of Foreign Affairs and Inria. This project aims at conducting common research activities in the areas of robotic mobile service and robotic assistance of human in different contexts of human life. French partners are Inria-emotion from Grenoble, Inria-IMARA from Rocquencourt and Institut Blaise Pascal from Clermont-Ferrand. Asian Partners are IRA-Lab from Taiwan, ISRC-SKKU from Suwon in Korea, ITS-Lab from Kumamoto in Japan and Mica Institute from Hanoi in Vietnam.

6.4.2. “Predimap”

[September 2011- September 2013]

Predimap is an ICT-ASIA project accepted in 2011 for 2 years. It is funded by the French Ministry of Foreign Affairs and Inria. This project aims at conducting common research activities in the area of perception in road environment. The main objective is the simultaneous use of local perception and Geographical Information Systems (GIS) in order to reach a global improvement in understanding road environment. Thus the research topics included in the project are: local perception, precise localization, map-matching and understanding of the traffic scenes. French partners are Inria-emotion from Grenoble, Heudiasyc team from CNRS/UTC, and Matis team from IGN. Foreign partners are Peking University and Shanghai Jiao Tong University in China, CSIS lab from Tokyo University in Japan and AIT Geoinformatics Center in Thailand.

6.4.3. “PRETIV”

[November 2011- October 2014]

Multimodal Perception and REasoning for Transnational Intelligent Vehicles" (PRETIV) is a three-year ANR project accepted in the framework of the Blanc International II Programme with participants from France (e-Motion of Inria, Heudiasyc of CNRS, PSA Peugeot Citroen DRIA in Velizy) and China (Peking University, PSA Peugeot Citroen Technical Center in Shanghai). The project aims at developing of an online multimodal perception system for a vehicle and offline reasoning methods, dealing with incompleteness and uncertainties in the models and sensor data, as well as at conducting experiments in typical traffic scenarios in France and China to create an open comparative dataset for traffic scene understanding. The perception system will incorporate vehicle localization, mapping of static environmental objects, detecting and tracking of dynamic objects in probabilistic frameworks through multimodal sensing data and knowledge fusion. The reasoning methods are based on sensor data to learn semantics, activity and interaction patterns (vehicle - other objects, vehicle - infrastructure) to be used as a priori information to devise effective online perception algorithms toward situation awareness. The comparative dataset will contain experimental data of typical traffic scenarios with ground-truth, which will be used to learn country-specific traffic semantics and it will be open to the public.

6.4.4. Visits of International Scientists

In 2011, M. Perrollaz went to Ohio Northern University for a short term research contract. From this collaboration, two papers were published in 2012: [24] and [33].

In 2012, Dimitrios Kanoulas, PhD Student at Northeastern University (Boston, USA) came at Inria for 4 months, within the framework of the REUSSI program.

6.4.4.1. Internship

Procopio Silveira-Stein, PhD at LAR (Laboratório de Automação e Robótica) at UA (Universidade de Aveiro) is in our team for november 2011 to july 2012.

6.4.5. Participation In International Programs

Submission of a international program with Taiwan called I-Rice. Partners for this proposition of an international center are IRA-lab (Taiwan university), LAAS, Inria and UPMC. Topics are related to Cognitive Systems and Robotics. Project under evaluation (hearing step).

Submission of an ANR Blanc GeoProb in collaboration with the spinoff Probayes (Mexico). Project on complementary list.

EXMO Project-Team (section vide)

FLOWERS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

7.1.1. *Fondation Cartier pour l'Art Contemporain*

The team has been collaborating with Fondation Cartier pour l'Art Contemporain in the context of the elaboration of the exhibition "Mathematical: A Beautiful Elsewhere" (<http://fondation.cartier.com>), to be held from October 2011 to March 2012, as well as with artist David Lynch, to build the robotic installation/experiment Ergo-Robots/FLOWERS Fields. This robotic installation illustrates, as well as allows to experiment in a realistic setup on the long term, computational models of curiosity-driven learning, human-robot interaction and language formation. Fondation Cartier participated to the funding of this experiment/installation. A dedicated web page is available at: <http://flowers.inria.fr/ergo-robots.php>

7.1.2. *Honda Research Institute USA Inc.*

Alexander Gepperth is collaborating with Honda Research Institute USA Inc. to implement and evaluate a real-time pedestrian detection and pose classification system with the goal of creating an industrial product in the coming years. Particular aspects of the project are robustness and real-time capability. Robustness is approached by the use of state-of-the-art image feature representations, a sophisticated hierarchy of linear and non-linear support vector classifiers, and dedicated tracking algorithms. Real-time capability is ensured by running the time-critical parts of the whole-image search on a GPU. A particular focus of the project is the use of synthetically rendered pedestrian images for detector training, which ameliorates the problem of insufficient training data. This work has been submitted to the "International Conference On Computer Vision and Pattern Recognition" (CVPR) as well as the "Intelligent Vehicles Symposium" (IV). Honda Research Institute USA Inc. support Alexander Gepperth by financing a post-doctoral researcher at ENSTA ParisTech during one year, grant volume: 50.000USD.

7.1.3. *Robert Kostal GmbH*

Alexander Gepperth has collaborated with Robert Kostal GmbH, Dortmund (Germany) on the subject of real-time pose recognition from 3D camera data. This project was conducted mainly through an internship student financed by Robert Kostal GmbH.

7.1.4. *Honda Research Institute Europe GmbH*

Alexander Gepperth and Louis-Charles Caron have collaborated with Honda Research Institute Europe GmbH, Offenbach (Germany) on the subject of real-time shape recognition for robotics. This project was conducted through an internship student financed by Honda Research Institute Europe GmbH, and through the visit of Louis-Charles Caron to Honda Research Institute Europe GmbH in summer 2012.

7.1.5. *Pal Robotics*

Freek Stulp is continuing his collaboration with Pal Robotics in Barcelona to implement and evaluate the use of Dynamic Motion Primitives on the commercial mobile platform 'REEM'. A particular focus of this project is to compare the respective advantages of motion primitives and sampling-based motion planning approaches in the context of human-robot interaction. Pal Robotics is supporting Freek Stulp by co-financing travel costs for regular project meetings in Barcelona: <http://www.pal-robotics.com/blog/freek-stulp-visited-pal-robotics/>. In 2012 this collaboration has lead to a paper at Humanoids [45], and a video at IROS, which was selected for an interactive session, "in consideration of the quality of your work".

GRAPHIK Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. ABES

Participants: Michel Leclaire, Michel Chein, Madalina Croitoru, Léa Guizol.

Collaboration with ABES. Funding of half a PhD grant (Léa Guizol, started in October 2011). See Sect. 6.3 .

7.2. CTFC

Participants: Patrice Buche, Jérôme Fortin, Awa Diattara.

We have initiated a national collaboration with the technical center of Comtois' cheese (CTFC : Centre Technique des Fromages Comtois). The objective of this collaboration is to design and test a platform for expert knowledge management. This will allow us to validate the integration of our theoretical tools on a new real-world application and strengthen GraphIK's involvement in agronomy applications. A master degree internship in collaboration with CTFC is done by Awa Diattara (University Gaston Berger of Saint-Louis, Sénégal).

7.3. INA

Participants: Michel Leclaire, Michel Chein, Marie-Laure Mugnier, Akila Ghersedine.

Funding of a PhD CIFRE-grant (Akila Ghersedine, started in May 2012). The objective of the collaboration is to propose automatic (or semi-automatic) technics for enriching authorities. An authority is a record that describes a named entity used in document metadata (e.g. a person, a domain). The elaboration of a solution requires addressing different problems: extraction of knowledge from textual metadata, entity resolution which is the core problematic of the Akila Ghersedine's thesis subject, and authority fusion.

IMAGINE Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts and Grants with Industry

7.1.1. *EADS - Idealization of components for structural mechanics (06/2011 - 06/2014)*

Participants: Jean-Claude Léon, Stefanie Hahmann.

Cifre PhD in partnership with EADS IW to generate the shape of mechanical components through dimensional reduction operations as needed for mechanical simulations, e.g. transformations from volume bodies to shells or plates forming surface models, usually non-manifold ones. The topic addressed covers also the shape detail removal process that takes place during the successive phases where subsets of the initial shape are idealized. Mechanical criteria are taken into account that interact with the dimensional reductions and the detail removal processes. The goal is to define the transformation operators such that a large range of mechanical components can be processed as automatically and robustly as possible. Some results from the homology computation topic may be used in the present context. An ongoing publication should address the description of the various stages of a component shape transformation in the context of assemblies.

7.1.2. *HAPTIHAND technology transfer project (Inria-HAPTION-Arts et Métiers ParisTech) (10/2012-12/2013)*

Participant: Jean-Claude Léon.

The objective is to transfer a device, named HandNavigator, that has been developed in collaboration with Arts et Métiers ParisTech/Institut Image, as add on to the 6D Virtuouse haptic device developed by HAPTION. The purpose of the HandNavigator is to monitor the movement of a virtual hand at a relatively detailed scale (movements of fingers and phalanxes), in order to create precise interactions with virtual objects. This includes monitoring the whole Virtuouse 6D arm and the HandNavigator in a virtual environment, for typical applications of maintenance simulation and virtual assembly in industry. The project covers the creation of an API coupled to physical engine to generate and monitor a realistic and intuitive use of the entire device, a research study about the optimal use of the device as well as a project management task.

IMARA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

In 2012, a new bilateral collaboration between Valeo and IMARA started involving the development of advanced driving assistance systems. The first topic was in the development of an advanced docking system using vision based perception and automatic control of the vehicle. The second topic has just started around driver monitoring using vision. Two bilateral contracts were signed as well as an associated NDA between both institutions.

IMEDIA2 Team (section vide)

IN-SITU Project-Team (section vide)

LAGADIC Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

7.1.1. Dassault Aviation

Participants: Laurent Coutard, François Chaumette.

no. Inria Rennes 5140, duration : 36 months.

This contract that started in 2009 supported Laurent Coutard's Ph.D. about automatic aircraft landing on carrier by visual servoing (see Section 6.2.6).

7.1.2. Fondation EADS

Participants: Antoine Petit, Eric Marchand.

no. Inria Rennes 5605, duration : 36 months.

This contract that started in March 2011 supports Antoine Petit's Ph.D. about 3D model-based tracking for applications in space (see Section 6.1.1).

7.1.3. Orange Labs

Participants: Pierre Martin, Eric Marchand.

no. URI 10CC310-03, duration : 36 months.

This contract started in February 2010. It is devoted to support the Cifre convention between Orange Labs and Université de Rennes 1 regarding Pierre Martin's Ph.D (see Section 6.3.3).

7.1.4. Astrium EADS

Participants: Tawsif Gokhool, Patrick Rives.

no. Inria Sophia 7128, duration : 36 months.

The objective of this project that started in February 2012 is to investigate the general problem of visual mapping of complex 3D environments that evolve over time. This contract supports Tawsif Gokhool's Ph.D.

7.1.5. ECA Robotics

Participants: Romain Drouilly, Patrick Rives.

no. Inria Sophia 7030, duration : 36 months.

This project that started in May 2012 aims at specifying a semantic representation well adapted to the problem of navigation in structured environment (indoors or outdoors). This contract is devoted to support the Cifre Convention between ECA Robotics and Inria Sophia Antipolis regarding Romain Drouilly's Ph.D.

LEAR Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Start-up Milpix

Participants: Hervé Jégou [Inria Rennes], Cordelia Schmid.

In 2007, the start-up company MILPIX has been created by a former PhD student of the LEAR team, Christopher Bourez. The start-up exploits the technology developed by the LEAR team. Its focus is on large-scale indexing of images for industrial applications. Two software libraries were licensed to the start-up: BIGIMBAZ and OBSIDIAN.

7.2. MBDA Aerospatiale

Participants: Albert Gordo, Michael Guerzhoy, Frédéric Jurie [University of Caen], Cordelia Schmid.

The collaboration with the Aerospatiale section of MBDA has been on-going for several years: MBDA has funded the PhD of Yves Dufurnaud (1999-2001), a study summarizing the state-of-the-art on recognition (2004), a one year transfer contract on matching and tracking (11/2005-11/2006) as well as the PhD of Hedi Harzallah (2007-2010). In September 2010 started a new three-year contract on object localization and pose estimation.

7.3. MSR-Inria joint lab: scientific image and video mining

Participants: Anoop Cherian, Adrien Gaidon, Zaid Harchaoui, Yang Hua, Cordelia Schmid.

This collaborative project, starting September 2008, brings together the WILLOW and LEAR project-teams with researchers at Microsoft Research Cambridge and elsewhere. It builds on several ideas articulated in the “2020 Science” report, including the importance of data mining and machine learning in computational science. Rather than focusing only on natural sciences, however, we propose here to expand the breadth of e-science to include humanities and social sciences. The project focuses on fundamental computer science research in computer vision and machine learning, and its application to archeology, cultural heritage preservation, environmental science, and sociology. Adrien Gaidon was funded by this project.

7.4. Xerox Research Center Europe

Participants: Zeynep Akata, Zaid Harchaoui, Thomas Mensink, Cordelia Schmid, Jakob Verbeek.

In a collaborative project with Xerox, starting October 2009, we work on cross-modal information retrieval. The challenge is to perform information retrieval and document classification in databases that contain documents in different modalities, such as texts, images, or videos, and documents that contain a combination of these. The PhD student Thomas Mensink was supported by a CIFRE grant obtained from the ANRT for the period 10/09 – 09/12. A second three-year collaborative project on large scale visual recognition started in 2011. The PhD student Zeynep Akata is supported by a CIFRE grant obtained from the ANRT for the period 01/11 – 01/14.

7.5. Technosens

Participants: Guillaume Fortier, Cordelia Schmid, Jakob Verbeek.

In October 2010 we started an 18 month collaboration with Technosens (a start-up based in Grenoble) in applying robust face recognition for application in personalized user interfaces. During 18 months an engineer financed by Inria’s technology transfer program, implemented and evaluated our face recognition system on Technosens hardware. Additional development aimed at dealing with hard real-world conditions.

MAGRIT Project-Team (section vide)

MAIA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

Participants: Arsène Fansi Tchango, Olivier Buffet, Vincent Thomas, Alain Dutech.

Arsène Fansi Tchango has currently a CIFRE grant for his PhD "Multi-Camera Tracking in Partially Observable Environment". This CIFRE is the result of the collaboration between Thales THERESIS and Inria Nancy Grand-Est (Section [6.1.5](#)).

MANAO Team (section vide)

MAVERICK Team (section vide)

METISS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. Contract with Canon Research Centre France SAS

Participants: Emmanuel Vincent, Joachim Thiemann, Nancy Bertin, Frédéric Bimbot.

Duration: 1.5 years (2012–2013). Partner: Canon Research Centre France SAS

This contract aims at transferring some of the research done within Metiss to products developed by Canon Inc.

7.1.2. Contract with Studio Maïa

Participants: Nancy Bertin, Frédéric Bimbot, Jules Espiau, Jérémy Paret, Emmanuel Vincent.

Duration: 3 years (2012–2014). Partners: Studio Maïa (Musiciens Artistes Interprètes Associés), Imaging Factory

This contract aims at transferring some of the research done within Metiss towards new services provided by Maïa Studio.

More specifically, the main objective is to adapt source separations algorithms and some other advanced signal processing techniques elaborated by Metiss in a user-informed context.

The objective is twofold:

- partial automation of some tasks which the user previously had to accomplish manually
- improved quality of separation and processing by exploiting user inputs and controls

The resulting semi-automated separation and processing will feed an integrated software used for the professional remastering of audiovisual pieces.

MIMETIC Team (section vide)

MINT Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. I-Lab Idées-3com (2009-2012)

Participants: Clément Moerman, Samuel Degrande, Damien Marchal, Laurent Grisoni [correspondant].

This year, our join research program with the small company Idées-3com is terminating. This program is supported by Inria, with a 3 year young engineer contract. During this join project, we have proposed interaction systems that is based on mobile phone, library for gestural interaction and a new navigation technique for fast and intuitive visiting of 3D virtual world [20].

MORPHEO Team

7. Bilateral Contracts and Grants with Industry

7.1. Contracts with Technicolor

A three year collaboration with Technicolor has started in 2011. The objective of this collaboration is to consider the capture and the interpretation of complex dynamic scenes in uncontrolled environments. A co-supervised PhD (Abdelaziz Djelouah) has started on this topic [6].

MOSTRARE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. *QuiXProc: Inria Transfer Project with Innovimax (2010-2012)*

Participants: Denis Debarbieux, Joachim Niehren [correspondent], Tom Sebastian.

QuiXProc is an Inria transfer project with Innovimax S.A.R.L in Paris, on the integration of XPath streaming algorithms into XProc, the XML coordination language of the W3C.

7.1.2. *Music Story*

Participants: Fabien Torre, Mikaela Keller [correspondent], Guillaume Bagan.

The MusicStory project is a transfer project with MusicStory, a company collecting musical metadata from heterogeneous sources. The project entails the design of automated data deduplication and field inference algorithms suited for MusicStory needs.

7.2. Bilateral Grants with Industry

7.2.1. *Cifre Xerox (2009-2012)*

Participants: Jean-Baptiste Faddoul, Rémi Gilleron, Fabien Torre [correspondent].

Gilleron and Torre continue supervising the PhD thesis (Cifre) of Jean-Baptiste Faddoul together with B. Chidlovski from the Xerox's European Research Center (XRCE).

7.2.2. *Cifre Innovimax (2010-2013)*

Participants: Tom Sebastian, Joachim Niehren [correspondent].

Niehren continue supervising the PhD thesis (Cifre) of Tom Sebastian on streaming algorithms for XSLT with M. Zergaoui from INNOVIMAX S.A.R.L. in Paris.

7.2.3. *Cifre SAP (2011-2014)*

Participants: Thomas Ricatte, Gemma Garriga, Rémi Gilleron [correspondent], Marc Tommasi.

Garriga, Gilleron and Tommasi supervise the PhD thesis (Cifre) of Thomas Ricatte together with Yannick Cras from SAP.

OAK Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

A collaboration grant is ongoing with DataPublica, which started based on our common work on Linked Data for Digital Cities.

ORPAILLEUR Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. The BioIntelligence Project

Participants: Mehwish Alam, Yasmine Assess, Aleksey Buzmakov, Adrien Coulet, Marie-Dominique Devignes, Amedeo Napoli [contact person], Malika Smaïl-Tabbone.

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

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

A second thesis is based on an extension of FCA involving Pattern Structures on Graphs. The idea is to be able to extend the formalism of pattern structures to graphs and to apply the resulting framework on molecular structures. In this way, it will be possible to classify molecular structures and reactions by their content. This will help practitioners in information retrieval tasks involving molecular structures or the search for particular reactions. In addition, an experiment was also carried out in the combination of supervised (distance-based clustering) and unsupervised learning (FCA) methods for the prediction of the configuration of inhibitors of the c-Met protein (which is very active in cancer).

In addition, a forthcoming thesis will be in concern with ontology re-engineering in the domain of biology. The objective is consider the content of the BioPortal ontologies (<http://bioportal.bioontology.org/>) and to design formal contexts and associated concept lattices which will become supports for ontological schemes. Moreover, this ontological schema will be completed thanks to external resources such as Wikipedia and domain knowledge as well. The global idea is to get definitions and thus classification capabilities for atomic or primitive concepts.

7.2. The Quaero Project

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

The Quaero project (<http://www.quaero.org>) is a program aimed at promoting research and industrial innovation on technologies for automatic analysis and classification of multimedia and multilingual documents. The partners collaborate on research and the realization of advanced demonstrators and prototypes of innovating applications and services for access and usage of multimedia information, such as spoken language, images, video and music.

In this framework, the Orpailleur team participates in the task called “Formal Representation of Knowledge for Guiding Recommendation”, whose objectives are to define methods and algorithms for building a “discovery engine” guided by domain knowledge and able to recommend a user some content to visualize. Such a discovery engine has to extend capabilities of usual recommender systems with a number of capabilities, e.g. to select among a huge amount of items (e.g. movie, video, music) those which are of interest for a user according to a given profile. In addition, the discovery engine should take into account contextual information that can be of interest such as news, space location, moment of the day, actual weather and weather forecast, etc. This contextual information changes within time and extracted information has to be continuously updated. Finally, the system has to be able to justify or explain the recommendations.

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

Finally, the discovery process has to be able to act as a classifier and as an inference engine at the same time for reasoning and classifying elements for recommendation and retrieval.

PAROLE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Introduction

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

In addition, we are involved in several regional projects.

7.2. Regional Actions

7.2.1. CPER MISN TALC

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

In addition to the co-management of this project, our team is also involved in scientific collaborative operations about text-to-speech alignment, in collaboration with the ATILF laboratory. Automatic alignment procedures are available, and a first version of speech data prosodic structuration has been developed.

7.3. National Contracts

7.3.1. ADT JSnoori

JSnoori ADT (2011-2012) is dedicated to porting main functions of WinSnoori in Java and the integration of new facilities targeting language learning. The main objective is to offer functions enabling the development of feedback for foreign language learning and more precisely the mastery of prosody.

This year the architecture has been changed to comply to the MVC (Model View Controller) model. This makes the management of interactions easier and this clearly separates speech processing algorithms from interactions. In addition forced alignment facilities and phonetic edition tools have been integrated for French and English. They enable the segmentation of sentences uttered by learners, and the annotation with international phonetic alphabet (IPS).

Preliminary versions of diagnosis and feedback of prosody have been incorporated for English (see 6.1.6.1).

7.3.2. ANR ARTIS

This contract started in January 2009 in collaboration with LTCI (Paris), Gipsa-Lab (Grenoble) and IRIT (Toulouse). Its main purpose is the acoustic-to-articulatory inversion of speech signals. Unlike the European project ASPI the approach followed in our group will focus on the use of standard spectra input data, i.e. cepstral vectors. The objective of the project is to develop a demonstrator enabling inversion of speech signals in the domain of second language learning.

This year the work has focused on the development of the inversion from cepstral data as input. We particularly worked on the comparison of cepstral vectors calculated on natural speech and those obtained via the articulatory to acoustic mapping. Bilinear frequency warping was combined with affine adaptation of cepstral coefficients. These two adaptation strategies enable a very good recovery of vocal tract shapes from natural speech. The second topic studied is the access to the codebook. Two pruning strategies, a simple one using the spectral peak corresponding to F2 and a more elaborated one exploiting lax dynamic programming applied on spectral peaks enable a very efficient access to the articulatory codebook used for inversion.

7.3.3. ANR ViSAC

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

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

Currently, we are mainly evaluating the system using both subjective and objective perceptual evaluation.

7.4. International Contracts

7.4.1. CMCU - Tunis University

This cooperation involves the LSTS (Laboratoire des systèmes et Traitement du Signal) of Tunis University headed by Prof. Nouredine Ellouze and Kais Ouni. This new project involves the investigation of automatic formant tracking, the modelling of peripheral auditory system and more generally speech analysis and parameterization that could be exploited in automatic speech recognition.

7.4.2. The Oesovox Project 2009-2011: 4 international groups associated...

It is possible for laryngectomees to learn a substitution voice: the esophageal voice. This voice is far from being natural. It is characterized by a weak intensity, a background noise that bothers listening, and a low pitch frequency. A device that would convert an esophageal voice to a natural voice would be very useful for laryngectomees because it would be possible for them to communicate more easily. Such natural voice restitution techniques would ideally be implemented in a portable device. In order to answer the Inria Euromed 3+3 Mediterranean 2006 call, the Inria Parole group (Joseph Di Martino, LORIA senior researcher, Laurent Pierron, Inria engineer and Pierre Tricot, Associated Professor at ENSEM) associated with the following partners:

- **Spain:** Begoña Garcia Zapirain, Deusto University (Bilbao-Spain), Telecommunication Department, PAS-"ESOIMPROVE" research group.
- **Tunisia:** Sofia Ben Jebara, TECHTRA research group, SUP'COM, Tunis.
- **Morocco:** El Hassane Ibn-Elhaj, SIGNAL research group, INPT, Rabat.

This project named LARYNX has been subsidized by the Inria Euromed program during the years 2006-2008. Our results have been presented during the Inria 2008 Euromed colloquium (Sophia Antipolis, 9-10 October 2008). During this international meeting, The French Inria institute decided to renew our project with the new name "OESOVOX". This new project will be subsidized during the years 2009-2011.

In the framework of the European COADVISE-FP7 program, two PhD students have assigned to the Euromed 3+3 Oesovox project. These students are, Miss Fadoua Bahja from INPT-Rabat (Morocco) whose PhD thesis title is "Detection of F0 in real-time for audio: application to pathological voices" and Mr. Ammar Werghi from SUP'COM-Tunis (Tunisia) whose PhD thesis title is "Voice conversion techniques applied to pathological voice repair". The activity reports of these two students for the year 2009 is described in [6.1.5](#) .

PERCEPTION Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contract with Samsung Electronics

We continued a collaboration with the Samsung Advanced Institute of Technology (SAIT), Seoul, South Korea. Within this project we develop a methodology able to combine data from several types of visual sensors (2D high-definition color cameras and 3D range cameras) in order to reconstruct, in real-time, an indoor scene without any constraints in terms of background, illumination conditions, etc. A software package was successfully installed in December 2012 at Samsung.

POTIOC Team (section vide)

PRIMA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. CAPEE - *plateforme Capteur d'Activité et de Présence pour l'Efficacité Énergétique*

Participants: James Crowley [correspondant], Lucas Nacsas, Amaury Nègre, Lukas Rummelhard.

In Cooperation with local PME Novazion, Inria has worked with and Schneider Electric to create a research platform for activity recognition for Smart Energy Systems. This system integrates information from multiple environmental sensors to detect and track people in indoor environments. Copies of this system have been installed at Schneider Electric Homes research group in Grenoble and in the Smart Spaces lab at Inria Montbonnot.

An associated software, named MultiSensor activity tracker, integrates information from multiple environmental sensors to keep track of the location and activity of people in a smart environment. This model is designed to be used by a home energy broker that would work in conjunction with a smart grid to manage the energy consumption of home appliances, balancing the needs of inhabitants with opportunities for savings offered by electricity rates. This database will also be used for by advisor services that will offer advice to inhabitants on the consequences to energy consumption and energy cost that could potentially result from changes to lifestyle or home energy use.

REVES Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Grants with Industry

6.1.1. Industrial Contracts and Donations

6.1.1.1. Autodesk

Participants: Pierre-Yves Laffont, Adrien Bousseau, George Drettakis.

We signed a technology transfer agreement with Autodesk RID technology on single-lighting condition intrinsic images. Autodesk has offered a significant research donation to REVES in support of our work on intrinsic images. Autodesk has also donated several licenses of Maya, 3DS Max and SketchBookPro.

6.1.1.2. Adobe

Participants: Pierre-Yves Laffont, Adrien Bousseau, George Drettakis.

In the context of our collaboration with Adobe (project with S. Paris and F. Durand from MIT), we have received a cash donation in support of our research and software donations of Adobe CS6 Creative Suite.

SEMAGRAMME Team (section vide)

SIROCCO Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contracts with Industry

7.1.1. *Contract with Astrium on compression of satellite images*

Participants: Jeremy Aghaei Mazaheri, Christine Guillemot, Claude Labit.

- Title : Compression of satellite images.
- Partners : Astrium, Inria-Rennes.
- Funding : Astrium.
- Period : Oct.11-Sept.14.

This contract with Astrium addresses the problem of sparse representation and dictionary learning for efficient sparse coding of video signals captured from a geostationary satellite. The goal is to develop a compact spatio-temporal representation taking advantage of the high redundancy present in the video of very high resolution and characterized by low motion. The first year has been dedicated to the study of different methods for learning tree-structured dictionaries, which can be well-tailored to the characteristics of the signals to be processed at each iteration of the greedy matching pursuit algorithms, while allowing efficient encoding of the produced sparse vectors. The performance of the dictionaries both in terms of PSNR versus sparsity and versus actual bit rate has been assessed.

7.1.2. *Collaboration with Alcatel on robust video compression*

Participants: Marco Bevilacqua, Christine Guillemot, Ronan Le Boulch, Aline Roumy.

- Title: Self adaptive video codec
- Funding: Joint research laboratory between Inria and Alcatel
- Period: Oct. 2010 - Dec. 2013.

In the framework of the joint research lab between Alcatel-Lucent and Inria, we participate in the ADR (action de recherche) Selfnets (or Self optimizing wireless networks). The objective is, jointly with the Alcatel Lucent team, to develop video representations and compression tools allowing smooth network adaptation on one hand and loss resilience on the other hand. In that context, the PhD thesis of M. Bevilacqua focuses on the development and study of image and video super-resolution as a tool for constructing scalable representations, hence enabling network adaptation of transmitted video streams. Despite the use of scalable representations and of error correcting codes, the reconstructed video after decoding may still suffer from residual losses. The effect of these residual losses can be mitigated using loss concealment techniques, as developed within the ANR-ARSSO project. However, loss concealment does not allow perfect recovery of the lost data. The reconstructed video after loss concealment is hence still corrupted by noise. Forward error correction using wyner-ziv encoded video is therefore also envisaged as an additional protection means, to cope with the residual noise after loss concealment.

7.1.3. *Contract with EutelSat on video traffic analysis*

Participants: Laurent Guillo, Aline Roumy.

- Title : Bit rate statistical analysis of HEVC encoded video in a broadcast transmission.
- Partners : EutelSat, Inria-Rennes.
- Funding : EutelSat.
- Period : Aug.12-Feb.13.

This contract with Eutelsat (starting in August 2012) is a consulting contract and aims at analyzing the variation of the video traffic, when the video is encoded by HEVC. Indeed, the main characteristic of satellite broadcasting, as proposed by Eutelsat, is to provide a nearly constant video quality, which is obtained by variable video traffic (bit rate). Then, to address this variability issue, statistical multiplexing is used to share the resource among the users. However, statistical multiplexing needs a precise analysis of this variability. In this contract, we therefore analyze this variability, when the video is compressed with the upcoming video compression standard HEVC.

7.1.4. Contract with SHOM (Service Hydrographique et Océanographique de la Marine)

Participants: Alan Bourasseau, Olivier Le Meur.

- Title: Oceanographic data compression
- Partners: SHOM, Alyotech, Univ. Rennes 1
- Funding: SHOM
- Period: 09/2012-02/2013.

The project consists in developing lossless and lossy compression algorithms for oceanographic data in partnership with ALYOTECH. The SIROCCO team contributes on the design and development of compression algorithms for this specific type of data, based on diffusion methods. The main constraint is the limited bandwidth used by the navy to transmit the data, i.e. an emitted message must be smaller than 4 kilo bytes. The obtained quality versus rate performances will be assessed against those given by state of the art solutions (HEVC-Intra and JPEG-2000).

7.2. Grants with Industry

7.2.1. CIFRE contract with Orange on Generalized lifting for video compression

Participants: Christine Guillemot, Bihong Huang.

- Title : Generalized lifting for video compression.
- Research axis : § 6.3.4 .
- Partners : Orange Labs, Inria-Rennes.
- Funding : Orange Labs.
- Period : Apr.12-Mar.15.

This contract with Orange labs. (starting in April. 2012) concerns the PhD of Bihong Huang and aims at investigating various forms of generalized lifting as efficient lossless and lossy coding operators in a video encoder. The generalized lifting is an extension of the lifting scheme of classical wavelet transforms which permits the creation of nonlinear and signal probability density function (pdf) dependent and adaptive transforms. This study is also carried out in collaboration with UPC (Ph. Salembier) in Barcelona.

7.2.2. CIFRE contract with Orange on 3D quality assessment

Participants: Darya Khaustova, Olivier Le Meur.

- Title : Objective Evaluation of 3D Video Quality.
- Research axis : § 6.1.1 .
- Partners : Orange Labs, Inria-Rennes.
- Funding : Orange Labs.
- Period : Dec.11-Nov.14.

This contract with Orange labs. (starting in Dec. 2011) concerns the PhD of Darya Khaustova and aims at developing a video quality metric for 3D content. The usage of 3D video is expected to increase in the next years. In order to ensure a good QoE (Quality of Experience), the 3D video quality must be monitored and accurately measured. The goal of this thesis is to study objective measures suitable for estimating 3D video quality. A comparison with ground truth as well as with the state-of-the-art 2D metrics should be carried out. To be as effective as possible, the feature of the human visual system should be taken into account.

7.2.3. CIFRE contract with Technicolor on sparse modelling of spatio-temporal scenes

Participants: Martin Alain, Safa Cherigui, Christine Guillemot.

- Title : Spatio-temporal analysis and characterization of video scenes
- Research axis : § 6.1.3 .
- Partners : Technicolor, Irista/Inria-Rennes.
- Funding : Technicolor, ANRT.
- Period : Ph.D Of S. Cherigui (Nov.09- Oct.12); Ph.D. of M. Alain (Oct.12-Sept.15).

A first CIFRE contract has concerned the Ph.D of Safa Cherigui from Nov.2009 to Oct.2012, in collaboration with Dominique Thoreau (Technicolor). The objective was to investigate texture and video scene characterization methods and models based on sparse and data dimensionality reduction techniques, as well as on concepts of epitomes. The objective was then to use these models and methods in different image processing problems focusing in particular on video compression. Among the main achievements, one can first cite novel Intra prediction techniques using data dimensionality reduction methods with correspondance map-aided K-NN search. A novel method has also been introduced for constructing epitome representations of an image, with rate-distortion optimization criteria. The epitome coupled with inpainting is used for image compression, showing significant performance gains with respect to H.264 Intra prediction modes. The above results have led to a best student paper award at IEEE-ICASSP 2012 [21], one nominated paper among the 11 finalists for a best student paper award at IEEE-ICIP 2012 [22], one journal publication in the IEEE Trans. on Image Processing [13] and to 6 patents.

The first PhD thesis has focused on spatial analysis, processing, and prediction of image texture. A second CIFRE contract (PhD thesis of Martin Alain) has hence just started to push further the study by addressing issues of spatio-temporal analysis and epitome construction, with applications to temporal prediction, as well as to other video processing problems such as video inpainting.

7.2.4. CIFRE contract with Thomson Video Networks (TVN) on Video analysis for HEVC based video coding

Participants: Nicolas Dhollande, Christine Guillemot, Olivier Le Meur.

- Title : Coding optimization of HEVC by using preanalysis approaches.
- Partners : Thomson Video Networks, Univ. Rennes 1.
- Funding : Thomson Video Networks (TVN).
- Period : Nov.12-Sept.15.

This contract with TVN (starting in Oct. 2012) concerns the PhD of Nicolas Dhollande and aims at performing a coding mode analysis and developing a pre-analysis software. HEVC standard is a new standard of compression including new tools such as advanced prediction modes. Compared to the previous standard H.264, HEVC's complexity is three to four times higher. The goal of this thesis is to infer the best coding decisions (prediction modes...) in order to reduce the computational complexity of HEVC. A pre-analysis or a first coding pass. This latter would provide useful estimates such as rate distortion characteristics of video, the set of quantization parameters (often called just QPs). These estimated characteristics would help to select quantization parameters for the second pass in order to reduce the computational complexity by keeping a good quality.

SMIS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

The SMIS project has a long lasting cooperation with Axalto, recently merged with Gemplus to form Gemalto, the world's leading providers of microprocessor cards. Gemalto provides SMIS with advanced hardware and software smart card platforms which are used to validate numbers of our research results. In return, SMIS provides Gemalto with requirements and technical feedbacks that help them adapting their future platforms towards data intensive applications. Meanwhile, we are developing partnerships with SMEs capable of building ad-hoc hardware prototypes conforming to our own design. We cooperate also with Santeos, an Atos Origin company developing software platforms of on-line medical services. Santeos is member of the consortium selected by the French Ministry of Health to host the French DMP (the national Personal Medical Folder initiative). This cooperation helps us tackling one of our targeted applications, namely the protection of medical folders.

7.2. DMSP Yvelines District grant (Nov 2010 - Apr. 2012)

Partners: Inria-SMIS (coordinator), Gemalto, UVSQ, Santeos
SMIS funding : 75k€

http://www-smis.inria.fr/_DMSP/accueil.php

Electronic Health Record (EHR) projects have been launched in most developed countries to increase the quality of care while decreasing its cost. Despite their unquestionable benefits, patients are reluctant to abandon their control of highly sensitive data to a distant server. The objective of the DMSP project is to complement a traditional EHR server with a secure and mobile personal medical folder (1) to protect and share highly sensitive data among trusted parties and (2) to provide a seamless access to the data even in disconnected mode. The DMSP architecture builds upon the technology designed in the PlugDB project (see above). It is currently experimented in the context of a medical-social network providing care and services at home for elderly people. The experiment in the field started in September 2011 with a targeted population of 120 volunteer patients and practitioners in the Yvelines district.

STARS Team (section vide)

TEXMEX Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. Consulting agreement with the LTU company

Participant: Hervé Jégou.

Following the interaction in the context of the Quaero Project, LTU and Inria have signed a consulting agreement. In this context, Hervé Jégou has provided some expertise to the company in March 2012.

7.2. Bilateral Grants with Industry

7.2.1. Contract with Orange Labs

Participants: Pascale Sébillot, Khaoula Elagouni.

Duration: 36 months, since October 2009.

K. Elagouni's Ph.D. thesis is supported by a CIFRE grant in the framework of a contract between Orange Labs and TEXMEX. The aim of the work is to investigate a more semantic approach to describe multimedia documents based on textual material found inside the images.

7.2.2. Contract with INA (*Institut national de l'audiovisuel*)

Participants: Guillaume Gravier, Ludivine Kuznik, Pascale Sébillot.

Duration: 36 months, since April 2011.

Ludivine Kuznik's Ph.D. thesis is supported by a CIFRE grant in the framework of a contract between INA and TEXMEX within the OSEO/QUAERO project. The aim of the work is to investigate a more semantic approach to structure and navigate very large collections of TV archives.

7.2.3. Contract with Orange Labs

Participants: Patrick Gros, Mohamed-Haykel Boukadida.

Duration: 36 months, since January 2012.

M.H. Boukadida's Ph.D. thesis is supported by a CIFRE grant in the framework of a contract between Orange Labs and TEXMEX. The aim of the work is to investigate the use of constraint programming to define a general framework for video summarization and repurposing.

7.2.4. Contract with INA

Participants: Guillaume Gravier, Bingjing Qu.

Duration: 36 months, since May 2012.

Bingjing Qu's Ph.D. thesis is supported by a CIFRE grant in the framework of a contract between INA and TEXMEX. The aim of the work is to infer the structure of collections of homogeneous documents.

7.2.5. Contract with Technicolor

Participants: Cédric Penet, Guillaume Gravier, Patrick Gros.

Duration: 36 months, since October 2010.

C. Penet's Ph.D. thesis is supported by a CIFRE grant in the framework of a contract between Technicolor and TEXMEX. The aim of the work is to develop methods to detect audio events and to apply these techniques to violence detection in films.

VR4I Team (section vide)

WAM Project-Team (section vide)

WILLOW Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. EADS (ENS)

Participants: Jean Ponce, Josef Sivic, Andrew Zisserman.

The WILLOW team has had collaboration efforts with EADS via tutorial presentations and discussions with A. Zisserman, J. Sivic and J. Ponce at EADS and ENS, and submitting joint grant proposals. In addition, Marc Sturzel (EADS) is doing a PhD at ENS with Jean Ponce and Andrew Zisserman.

7.2. MSR-Inria joint lab: Image and video mining for science and humanities (Inria)

Participants: Jean Ponce, Josef Sivic, Ivan Laptev.

This collaborative project, already mentioned several times in this report, brings together the WILLOW and LEAR project-teams with MSR researchers in Cambridge and elsewhere. The concept builds on several ideas articulated in the “2020 Science” report, including the importance of data mining and machine learning in computational science. Rather than focusing only on natural sciences, however, we propose here to expand the breadth of e-science to include humanities and social sciences. The project we propose will focus on fundamental computer science research in computer vision and machine learning, and its application to archaeology, cultural heritage preservation, environmental science, and sociology, and it will be validated by collaborations with researchers and practitioners in these fields.

7.3. Google: Learning to annotate videos from movie scripts

Participants: Josef Sivic, Ivan Laptev, Jean Ponce.

The goal of this project is to automatically generate annotations of complex dynamic events in video. We wish to deal with events involving multiple people interacting with each other, objects and the scene, for example people at a party in a house. The goal is to generate structured annotations going beyond simple text tags. Examples include entire text sentences describing the video content as well as bounding boxes or segmentations spatially and temporally localizing the described objects and people in video. This is an extremely challenging task due to large intra-class variation of human actions. We propose to learn joint video and text representations enabling such annotation capabilities from feature length movies with coarsely aligned shooting scripts. Building on our previous work in this area, we aim to develop structured representations of video and associated text enabling to reason both spatially and temporally about scenes, objects and people as well as their interactions. Automatic understanding and interpretation of video content is a key-enabling factor for a range of practical applications such as content-aware advertising or search. Novel video and text representations are needed to enable breakthrough in this area.

WIMMICS Team

7. Bilateral Contracts and Grants with Industry

7.1. Alcatel Lucent Bell

We initiated a Research Contract (CRE) and CIFRE PhD Thesis (2011-2013) on Social objects, object-centered sociality, and object-centered social networks to propose mobile context-based notification application in a semantic and pervasive Web. This work will explore spreading algorithms in typed graphs.

7.2. SAP

We have a PhD Thesis (Cifre) with SAP Research on *Usage semantics of analytics and Business Intelligence tools*.

ZENITH Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Data Publica (2010-2013)

Participants: Emmanuel Castanier, Patrick Valduriez.

Data Publica (<http://www.data-publica.com>) is a startup providing a web portal for open data which can be public, private, free or charged. We collaborate with Data Publica through our WebSmach tool on technologies for automatic schema extraction and matching from high numbers of data sources. A first contribution has been the development of an Excel extraction component based on machine learning techniques.