Activity Report 2015

Section Contracts and Grants with Industry

ALGORITHMICS, PROGRAMMING, SOFTWARE AND ARCHITECTURE

NETWORKS, SYSTEMS AND SERVICES, DISTRIBUTED COMPUTING

ALF Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Intel research grant ALF-INTEL2014-8957
Participants: André Seznec, Fernando Endo.

Intel is supporting the research of the ALF project-team on "Mixing branch and value prediction to enable high sequential performance".

8.2. Bilateral Grants with Industry

8.2.1. Nano 2017 PSAIC
Participants: Arif Ali Ana-Pparakkal, Erven Rohou, Emmanuel Riou.

Nano 2017 PSAIC is a collaborative R&D program involving Inria and STMicroelectronics. The PSAIC (Performance and Size Auto-tuning through Iterative Compilation) project concerns the automation of program optimization through the combination of several tools and techniques such as: compiler optimization, profiling, trace analysis, iterative optimization and binary analysis/rewriting. For any given application, the objective is to devise through a fully automated process a compiler profile optimized for performance and code size. For this purpose, we are developing instrumentation techniques that can be focused and specialized to a specific part of the application aimed to be monitored.

The project involves the Inria teams ALF, AriC, CAMUS and CORSE. ALF contributes program analyses at the binary level, as well as binary transformations. We will also study the synergy between static (compiler-level) and dynamic (run-time) analyses.

ANTIQUE Project-Team (section vide)

AOSTE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Kontron CIFRE*

This contract, ended in April 2015, provided partial support for the PhD thesis of Mohamed Bergach. It was extended until the end of September with a direct collaborative contrat funded by Kontron until the PhD defense [16]

The topic is to study how to efficiently implement various sizes of the FFT (Fast Fourier Transform) algorithm on multicore and GP-GPU architectures from the range of processors used at Kontron, in order to understand in a second phase how to best allocate several such algorithms in parallel, as part of a single application, in the most efficient way (regarding performance but also power consumption and thermal constraints).

8.1.2. *Airbus CIFRE*

This contract, started on March 2014, provides full support for the PhD thesis of Cristian Maxim. The thesis concerns the statistical timing analysis while different variability factors are taken into account. This method is built on top of existing statistical approaches while proving appropriate programs for training these methods and thus learning from the history of the execution.

8.1.3. *CNES/Airbus DS*

Financing comes here through the CNES R&T programme, which has partly funded the post-doctorate of Raul Gorcitz (Sep 2013-Aug 2015) and the acquisition of an industry-grade evaluation platform based on TTEthernet and VxWorks 653.

The objective of our collaboration with Airbus Defence and Space and the CNES is to determine how the design and implementation of embedded software and system/network configuration can be largely automated in an aerospace context, while preserving an assurance level superior to that of the Ariane 5 flight program. We are exploring the novel algorithms developed and implemented in the Lopht tool.

ARIC Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

- Marie Paindavoine is supported by an Orange Labs PhD Grant (from October 2013 to November 2016). She works on privacy-preserving encryption mechanisms.
- Within the program Nano 2017, we collaborate with the Compilation Expertise Center of STMicroelectronics on the theme of floating-point arithmetic for embedded processors.

<p style="color:red; text-align:center">ATEAMS Project-Team</p>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

With the **ING bank** we a running a four-year project on advising and research in functional and non-functional properties of a part of the ING IT-infrastructure. The project involves modelling a large part of the product portfolio and using state-of-the-art MDE technology to simulate, verify and generate part of its IT infrastructure. The funding of this project is approximately 50% industry, 50% grants from CWI & NWO.

CAIRN Project-Team (section vide)

CAMUS Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

The CAMUS team is taking part of the NANO 2017 national research program and its sub-project PSAIC (Performance and Size Auto-tuning thru Iterative Compilation) with the company STMicroelectronics, starting January 2015. Luis Esteban Campostrini has been recruited as PhD student in this project. His work is focusing in extending advanced loop optimization techniques to nonlinear loops using a linear virtual data layout remapping. Artiom Baloian has been recruited in October 2015 as research engineer, in order to make the Apollo framework applicable to ARM Cortex platforms and to merge all the last extensions inside the framework.

8. Bilateral Contracts and Grants with Industry

8.1. Training and Consulting with HTCS

The training and consulting activities begun in 2012 with the HTCS company have been pursued, and the existing contract has been renewed in identical form for 2013, 2014 and 2015.

8.2. Consulting with Docapost

In the context of our activities on electronic voting, in collaboration with the Cassis team, we had a consulting contract with the Docapost company. The goal was to evaluate their e-voting product and to propose various directions for future improvements.

CARTE Project-Team (section vide)

CASCADE Project-Team (section vide)

CASSIS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Electronic Voting Systems

Participant: Véronique Cortier.

A collaboration agreement has been signed between Loria and Scytl, a Spanish company who is proposing solutions for the organization of on-line elections, including legally binding elections, in several countries. We have a collaboration with David Galindo (who joined Scytl in July 2014) on defining security properties for e-voting (privacy as well as verifiability properties) and designing e-voting schemes that meet all these properties. Further contracts may cover the analysis of the solutions developed at Scytl.

8.2. Electronic Voting Systems

Participants: Véronique Cortier, Stéphane Glondu.

Docapost has signed a 6 months contract with Cassis for defining potential colaborations around the voting protocol used by Docapost. We have examined their source code and proposed a list of enhancements, delivered at the end of the contract. Based on this list, further collaborations should take place in the following years.

CELTIQUE Project-Team (section vide)

COMETE Project-Team (section vide)

<div align="center">**COMPSYS Project-Team**</div>

8. Bilateral Contracts and Grants with Industry

8.1. ManycoreLabs Project with Kalray

Compsys was part of 3-years a bilateral contract with Kalray called ManycoreLabs, funded by "Investissements d'avenir pour le développement de l'économie numérique". The goal of this project was to allow the company Kalray, 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 included Bull, CAPS Entreprise, Digigram, Thales, Renault. Academic partners are CEA, Inria (Parkas, Compsys, and Corse), VERIMAG.

Compsys role was to explore analysis and compilation techniques linked to streaming languages, with the Kalray MPPA platform as long-term target. The research on OpenStream described in Section 7.8 corresponds to extensions of the work package WP 2.5.3. This study showed the need for extending polyhedral techniques to polynomials, which is one of the motivation of the work described in Section 7.11 . The work on parametric tiling (Section 7.7), first in the context of FPGA, then of GPUs, was also a first step towards the automatic generation of blocking algorithms for multicores such as the Kalray MPPA.

This project ended in June 2015.

8.2. Technological Transfer: XtremLogic Start-Up

The XTREMLOGIC start-up (http://xtremlogic.com/) was initiated, initially with the name Zettice, at the end of 2010 by Alexandru Plesco and Christophe Alias, after the PhD thesis of Alexandru Plesco under the guidance of Christophe Alias, Alain Darte and Tanguy Risset. The goal of XTREMLOGIC is to build on the disruptive technologies emerging from the polyhedral compilation community, and particularly the results obtained in Compsys, to provide the HPC market with efficient and communication-optimal circuit blocks (IP) for FPGA.

The compiler technology transferred to XTREMLOGIC (see Sections 6.2 and 7.5) is the result of a tight collaboration between Christophe Alias and Alexandru Plesco. XTREMLOGIC is one way to spread the polyhedral technology to industry. In 2015, XTREMLOGIC was supported by the Rhône Développement Initiative 2015 (loan).

CONVECS Project-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 (see § 6.5.1), under the supervision of Guilhem Barthes (STMicroelectronics), Christophe Chevallaz (STMicroelectronics), Grégory Faux (STMicroelectronics), Radu Mateescu (CONVECS), Wendelin Serwe (CONVECS), and Massimo Zendri (STMicroelectronics).

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contract with Industry

- Tirex is a bilateral contract with Kalray. The subject is a prototyping of hybrid alias analysis. The collaboration led to a recent publication which corresponding work is described in 6.4 .

7.2. Bilateral Grants with Industry

- ManyCoreLabs is a bilateral Grant (BGLE) with Kalray. CORSE is involved in the development of generalized register tiling.
- PSAIC Nano2017 is a bilateral Grant with STMicroelectronics. CORSE is involved in the development of trace analysis and hybrid compilation.
- DEMA Nano2017 is a bilateral Grant with STMicroelectronics. CORSE is involved in the development of debugging of multithreaded applications.

7.3. CIFRE contracts

- CORSE is involved in another contract with Kalray associated with the CIFRE PhD of Duco van Amstel. The subject of the collaboration is related to fine grain scheduling. Corresponding work is described in 6.3 .
- CORSE is involved in a contract with Aselta for the CIFRE thesis of Nassim Halli.
- CORSE is also involved in two contracts with STMicroelectronics for the CIFRE theses of Serge Emteu and Oleg Iegorov.

CRYPT Team (section vide)

DECENTRALISE Team (section vide)

DEDUCTEAM Team (section vide)

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

Worldline Wordline is a leader in B2B applications development, and is in the front line to provide new technical solution in the Web 2.0 era. We have a CIFRE partnership contract on the study of flow based architectures both at the data centers and at the Web browser level.

DREAMPAL Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Collaboration contract with Nolam Embedded Systems: In conjunction with the CIFRE grant of Venkatasubramanian Viswanathan, a collaboration contract is established with Nolam ES. The objective is to design an innovative embedded computing platform supporting massively parallel dynamically reconfigurable execution model. The use-cases of this platform cover several application domains such as medical, transportation and aerospace.

Collaboration contract with NAVYA: In conjunction with the doctoral grant of Karim Ali, a collaboration contract is established with NAVYA. The objective is to design an innovative embedded system dedicated for dynamic obstacle detection and tracking for autonomous vehicle navigation.

ESTASYS Team (section vide)

GALAAD2 Team (section vide)

GALLIUM Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *The Caml Consortium*
Participants: Xavier Leroy [**contact**], Damien Doligez, Didier Rémy.

The Caml Consortium is a formal structure where industrial and academic users of OCaml 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:

- Aesthetic Integration
- Bloomberg
- CEA
- Citrix
- Dassault Aviation
- Dassault Systèmes
- Esterel Technologies
- Jane Street
- LexiFi
- Microsoft
- OCamlPro
- SimCorp

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

8.1.2. *Scientific Advisory for OCamlPro*
Participant: Fabrice Le Fessant.

OCamlPro is a startup company founded in 2011 by Fabrice Le Fessant to promote the use of OCaml in the industry, by providing support, services and tools for OCaml to software companies. OCamlPro performs a lot of research and development, in close partnership with academic institutions such as IRILL, Inria and Univ. Paris Sud, and is involved in several collaborative projects with Gallium, such as the Bware ANR, the Vocal ANR and the Secur-OCaml FUI.

Since 2011, Fabrice Le Fessant is a scientific advisor at OCamlPro, as part of a collaboration contract for Inria, to transfer his knowledge on the internals of the OCaml runtime and the OCaml compilers.

<p style="text-align:center; color:red;">**GEOMETRICA Project-Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Cifre Contract with Geometry Factory*

Mael Rouxel-Labbé's PhD thesis is supported by a Cifre contract with GEOMETRY FACTORY (http://www.geometryfactory.com). The subject is the generation of anisotropic meshes.

8.1.2. *Commercialization of cgal packages through Geometry Factory*

In 2015, GEOMETRY FACTORY (http://www.geometryfactory.com) had the following new customers for CGAL packages developed by GEOMETRICA:

     CSM3D (UK, Cad chaussures): surface parametrization

     Silvaco (USA, simulation) : 3d mesh generation

     Cimmi (Canada): Approximation of Ridges and Umbilics on Triangulated Surface Meshes, Estimation of Local Differential Properties, AABB Tree, Principal Compoment Analysis, Point Set Processing

     Varel (France, forage): 2D triangulations

     Powel (Norway, GIS): point set processing, surface reconstruction

     ExxonMobil (USA) : 2D triangulations, surface parametrization

     Metrologic (France, metrology): point set processing

     Geomage (Israel, oil&gas): 2D and 3D triangulations

     Corvid (USA, simulation) : 3D triangulations

     Medicim (Belgium, medical imaging): 3D mesh generation

     Huntsman (Belgium), Pasco (Japan), Qualcomm (USA), Facebook (USA): industrial research licenses

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

8.1.1. Alcatel-Lucent

Within the framework of the joint lab Inria-ALU, Grace and Alcatel-Lucent collaborate on the topic of Private Information Retrieval: that is, enabling a user to retrieve data from a remote database while revealing neither the query nor the retrieved data. (This is not the same as data confidentiality, which refers to the need for users to ensure secrecy of their data; this is classically obtained through encryption, which prevents access to data in the clear.)

A typical application would be a centralized database of medical records, which can be accessed by doctors, nurses, and so on. A desirable privacy goal would be that the central system does not know which patient is queried for when a query is made, and this goal is precisely achieved by a Private Information Retrieval protocol. Note also that in this scenario the database is not encrypted, since many users are allowed to access it.

We are exploring applications of Locally Decodable Codes to Private Information Retrieval in the multi-cloud (multi-host) setting, to ensure both secure, reliable storage, and privacy of database queries.

Our progress on information sets of multiplicity codes was presented at the ISIT 2015 conference [18]

HYCOMES Team (section vide)

LFANT Project-Team (section vide)

<p style="text-align:center">**MARELLE Project-Team**</p>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

In 2015, we discussed a contract with a potential industrial partner, but these discussions are currently covered by a non-disclosure agreement. We expect this discussion to become visible in 2016.

<p style="text-align:center">**MEXICO Project-Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

At present, our industrial cooperations are centered in the IRT SystemX, see below; there are currently no *bilateral* agreements.

MUTANT Project-Team (section vide)

PARKAS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Technology Transfer Project, partly funded by the TETRACOM grant and by Kalray.

7.2. Bilateral Grants with Industry

Polly Labs initiative. Fully funded by ARM.

PARSIFAL Project-Team (section vide)

PI.R2 Project-Team (section vide)

<p style="text-align: center; color: red;">**POLSYS Project-Team**</p>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Gemalto. Gemalto is an international IT security company providing software applications, secure personal devices such as smart cards and token, POLSYS is currently working with Gemalto – thanks to a CIFRE PhD grant – on the security analysis of code-based cryptosystems (Participants: J.-C. Faugère, L. Perret, F. Urvoy de Portzamparc).

7.2. Industrial Transfer

Until the mid 2000's, multivariate cryptography was developing very rapidly, producing many interesting and versatile public-key schemes. However, many of them were soon successfully cryptanalysed (a lot have been done in this group). As a consequence, the confidence in multivariate cryptography cryptosystems declined. It seems that there have emerged new important reasons for renewal of the interest in a new generation of multivariate schemes. In the past two years, the algorithms for solving the Discrete Logarithm Problem over small characteristic fields underwent an extraordinary development. This clearly illustrates the risk to not consider alternatives to classical assumptions based on number theory. In parallel, two of the most important standardization bodies in the world, NIST and ETSI have recently started initiatives for developing cryptographic standards not based on number theory, with a particular focus on primitives resistant to quantum algorithms. An objective here is then to focus on the design of multivariate schemes.

The team is now involved in the industrial transfer of post-quantum cryptography. The project is supervised by SATT-LUTECH. SATT Lutech specializes in the processing and transfer of technologies from research laboratories of its shareholders: Inria, CNRS, University of Technology of Compiègne, National Museum of Natural History, Institute Curie, Université Panthéon-Assas, Paris Sorbonne University and National School of Industrial Creation).

The team has recently developed, in partnership with a mobile application development company (WASSA), an Android app for smartphones (Samsung G5 type) that uses multivariate cryptography. The application has been tested mid-November in a series of experiments supervised by DGA and French Minsitry of Defense. The experiment gathered a total of hundred participants from various operational units. This is a first milestone in the maturation project whose goal is to create a start-up.

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- PhD Grant CIFFRE, 2015-2018, for Jean-Michael Célérier, in partnership with Blue Yeti (Royan),

<p align="center" style="color:red">POSTALE Team</p>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- EDF R&D: this is a collaboration with the department SINETICS of EDF in the area of high-performance computing.
  Participants: Marc Baboulin, Amal Khabou.

  It concerns two differents topics:

  – Enhancing performance of numerical solvers using accelerators (postdoc started in October 2014).
  – Studying numerical quality and reproducibility in HPC exascale applications (ongoing ANR submission).

- NumScale: Collaboration with the small size company NumScale (PME, 10 people) NumScale on C++ parallel code generation technology. NumScale is a start-up created in 2012 as the result of a Digiteo/University Paris Sud technological transfer program (Digiteo OMTE). NumScale exploits scientific results and tools based around code generation for parallel programs as well as advanced code optimization techniques developed by members of the team.

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. IPSec with pre-shared key for MISTIC security

Title: IPSec with pre-shared key for MISTIC security.

Type: CIFRE.

Duration: Juillet 2014 - Juillet 2017.

Coordinator: Inria

Others partners: Privatics, Moais and Incas-ITSec.

<div align="center">**PROSECCO Project-Team**</div>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

The miTLS project received a grant from Mozilla for work on TLS 1.3. Catalin Hritcu received a PhD grant from Microsoft Research.

SECRET Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

- **Thales** $(02/14 \to 01/17)$
  Funding for the supervision of Julia Chaulet's PhD.
  30 kEuros.

<p style="text-align:center;color:red;font-weight:bold;">SPADES Project-Team</p>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- INRIA and Orange Labs have established this year a joint virtual research laboratory, called I/O LAB. We have been heavily involved in the creation of the laboratory and are actively involved in its operation (Jean-Bernard Stefani is one of the two co-directors of the lab). I/O LAB focuses on the network virtualization and cloudification. As part of the work of I/O LAB, we have cooperated with Orange Lab, as part of a cooperative research contract funded by Orange, on defining architectural principles and frameworks for network cloud infrastructures encompassing control and management of computing, storage and network resources.

- With Daimler (subcontracting via iUTBS): We have applied our recent improvements regarding the analysis of deadline miss models for real-time systems to the specific needs of Daimler in the context of CAN buses.

7.2. Bilateral Grants with Industry

With Thales: Early Performance assessment for evolving and variable Cyber-Physical Systems. This CIFRE grant funds the PhD of Christophe Prévot.

SPECFUN Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- *Mathematical Components* (project of the MSR–INRIA Joint Centre).
  Goal: Investigate the design of large-scale, modular and reusable libraries of formalized mathematics, using the Coq proof assistant. This project successfully formalized the proof of the Odd Order Theorem, resulting in a corpus of libraries related to various areas of algebra.
  Leader: G. Gonthier (MSR Cambridge). Participants: F. Chyzak, A. Mahboubi.
  Website: http://www.msr-inria.fr/projects/mathematical-components/.

SUMO Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Joint Alstom-Inria research lab: Several researchers of SUMO are involved in the joint research lab of Alstom and Inria, in a common research team called P22. On Alstom side, this joint research team involves researchers of the ATS division (Automatic Train Supervision). The objective of this joint team is to evaluate regulation policies of urban train systems, to assess their robustness to perturbations and failures, to design more efficient regulation policies and finally to provide decision support for human regulators. The project started in march 2014. Alstom agreed to start a second phase of the project in 2016, for a duration of three years. This covers in particular the CIFRE PhD of Karim Kecir.

TASC Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Labcom TransOp*
Participants: Charles Prud'Homme, Xavier Lorca.

Title: TransOp.

Duration: 2014-2016.

Type: **new project**.

Budget: 300000 Euros.

Others partners: Eurodécision.

The goal of the project is to handle robustness in the context of industrial timetabling problems with constraint programming using CHOCO. The project is managed by Xavier Lorca.

8.2. Bilateral Grants with Industry

8.2.1. *Gaspard Monge*
Participants: Nicolas Beldiceanu, Helmut Simonis.

Title: Gaspard Monge 2.

Duration: 2014.

Type: **continuation of 2012,2013 project**.

Budget: 6000 Euros.

Others partners: EDF.

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 (continuation of last years projects) is to provide a systematic reformulation of time-series constraints in term of linear constraints that can be used in a MIP solver.

<p style="text-align: center; color: red;">**TEA Project-Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Toyota Info-Technology Centre (2014+)*

Title: Co-Modeling of Safety-Critical Multi-threaded Embedded Software for Multi-Core Embedded Platforms

Inria principal investigator: Jean-Pierre Talpin

International Partner (Institution - Laboratory - Researcher):

Toyota Info-Technology Centre, Mountain View, California

Virginia Tech Research Laboratories, Arlington

Duration: renewed yearly since 2014

Abstract: We started a new project in April 2014 funded by Toyota ITC, California, to work with Huafeng Yu (a former post-doctorate of team ESPRESSO) and with VTRL as US partner. The main topic of our project is the semantic-based model integration of automotive architectures, virtual integration, toward formal verification and automated code synthesis. This year, Toyota ITC is sponsoring our submission for the standardisation of a time annex in the SAE standard AADL.

In a second work-package, we aim at elaborating a standardised solution to virtually integrate and simulate a car based on heterogeneous models of its components. This year, it will be exemplified by the elaboration of a case study in collaboration with Virginia Tech. The second phase of the project will consist of delivering an open-source, reference implementation, of the proposed AADL standard and validate it with a real-scale model of the initial case-study.

8.2. Bilateral Grants with Industry

8.2.1. *Mitsubishi Electric R&D Europe (2015-2018)*

Title: Analysis and verification for correct by construction orchestration in automated factories

Inria principal investigator: Jean-Pierre Talpin, Simon Lunel

International Partner: Mitsubishi Electric R&D Europe

Duration: 2015 - 2018

Abstract: The primary goal of our project is to ensure correctness-by-design in cyber-physical systems, i.e., systems that mix software and hardware in a physical environment, e.g., Mitsubishi factory automation lines. We plan to explore a multi-sorted algebraic framework for static analysis and formal verification starting from a simple use case extracted from Mitsubishi factory automation documentations. This will serve as a basis to more ambitious research where we intend to leverage recent advance in type theory, SMT solvers for nonlinear real arithmetic (dReal and δ-decidability) and contracts theory (meta-theory of Benveniste et al., Ruchkin's contracts) to provide a general framework of reasoning about heterogeneous factory components.

TOCCATA Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *ProofInUse Joint Laboratory*

Participants: Claude Marché [contact], Jean-Christophe Filliâtre, Andrei Paskevich.

ProofInUse is a joint project between the Toccata team and the SME AdaCore. It was selected and funded by the ANR programme "Laboratoires communs", starting from April 2014, for 3 years http://www.spark-2014.org/proofinuse.

The SME AdaCore is a software publisher specializing in providing software development tools for critical systems. A previous successful collaboration between Toccata and AdaCore enabled *Why3* technology to be put into the heart of the AdaCore-developed SPARK technology.

The goal is now to promote and transfer the use of deduction-based verification tools to industry users, who develop critical software using the programming language Ada. The proof tools are aimed at replacing or complementing the existing test activities, whilst reducing costs.

VEGAS Project-Team (section vide)

<p style="text-align:center;color:red;font-weight:bold;">VERIDIS Project-Team</p>

8. Bilateral Contracts and Grants with Industry

8.1. ADN4SE Project

Participants: Stephan Merz, Martin Riener.

Joint work with Damien Doligez of Inria Paris Rocquencourt.

The ADN4SE project started in 2013 within *Programme d'Investissements d'Avenir: Briques Génériques du Logiciel Embarqué* and is coordinated for Inria by the Gallium team in Rocquencourt. The objective of this project is to develop and commercialize the PharOS real-time micro-kernel operating system. In cooperation with researchers at CEA List, we are contributing to the project by verifying key properties (in particular, determinism) of a high-level model of the system written in TLA$^+$. The proof was completed in the summer of 2015, and the project ended in December 2015.

8.2. Proving formulas over streams

Participants: Pascal Fontaine, Stephan Merz.

In an exploratory project with *Atelier de Qualification Logicielle* of RATP, we studied the use of SAT solving techniques for proving certain formulas expressed over infinite Boolean streams. Such formulas arise as proof obligations generated from SCADE models used by RATP, and they are currently proved using proprietary tools. We showed that in the absence of recursive definitions, checking a small number of instances of a proof obligation ensures its validity for all instances. For models that contain recursive definitions, the bound on the number of instances that must be checked becomes much bigger, making it unwieldy to apply the same technique, and inductive reasoning should be used. We implemented our proposal in a prototype checker and validated it using several benchmarks provided by RATP.

ACUMES Team (section vide)

APICS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contract CNES-Inria-XLIM

This contract (reference Inria: 7066, CNES: 127 197/00) involving CNES, XLIM and Inria, focuses on the development of synthesis algorithms for N-ports microwave devices. The objective is to derive analytical procedures for the design of multiplexers and routers, as opposed to "black box optimization" which is usually employed in this field (for $N \geq 3$). Emphasis at the moment bears on so-called "star-topologies".

7.2. Contract CNES-Inria-UPV/EHU

This contract (reference CNES: RS14/TG-0001-019) involving CNES, University of Bilbao (UPV/EHU) and Inria aims at setting up a methodology for testing the stability of amplifying devices. The work at Inria is concerned with the design of frequency optimization techniques to identify the unstable part of the linearized response and analyze the linear periodic components.

7.3. Contract BESA GmbH-Inria

This is a research agreement between Inria (Apics and Athena teams) and the German company BESA [0], which deals with head conductivity estimation and co-advising of the doctoral work of C. Papageorgakis, see Section 6.1.1 . BESA is funding half of the corresponding research grant, the other half is supported by Region PACA (BDO), see Section 8.1 .

7.4. Flextronics

Flextronics, active in the manufacturing of communication devices all over the world, bought two sets of licenses for Presto-HF and Dedale-HF. Deployment of our tools in their production facilities for wireless communication units is being studied.

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[0]http://www.besa.de/

ASPI Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral contracts with industry

6.1.1. *Optimization of sensors location and activation (DUCATI) — contract with DGA / Techniques navales*
Participant: François Le Gland.

See 3.3 , 4.2 and 5.4

Inria contract ALLOC 7326 — April 2013 to December 2016.

This is a collaboration with Christian Musso (ONERA, Palaiseau) and with Sébastien Paris (LSIS, université du Sud Toulon Var).

The objective of this project is to optimize the position and activation times of a few sensors deployed by one or several platforms over a search zone, so as to maximize the probability of detecting a moving target. The difficulty here is that the target can detect an activated sensor before it is detected itself, and it can then modify its own trajectory to escape from the sensor. This makes the optimization problem a spatio–temporal problem. Our contribution has been to study different ways to merge two different solutions to the optimization problem : a fast, though suboptimal, solution developped by ONERA in which sensors are deployed where and when the probability of presence of a target is high enough, and the optimal population–based solution developped by LSIS and Inria in a previous contract (Inria contract ALLOC 4233) with DGA / Techniques navales.

6.2. Bilateral grants with industry

6.2.1. *Hybrid indoor navigation — PhD grant at CEA LETI*
Participants: François Le Gland, Kersane Zoubert–Ousseni.

This is a collaboration with Christophe Villien (CEA LETI, Grenoble).

The issue here is user localization, and more generally localization–based services (LBS). This problem is addressed by GPS for outdoor applications, but no such general solution has been provided so far for indoor applications. The desired solution should rely on sensors that are already available on smartphones and other tablet computers. Inertial solutions that use MEMS (microelectromechanical system, such as accelerometer, magnetometer, gyroscope and barometer) are already studied at CEA. An increase in performance should be possible, provided these data are combined with other available data: map of the building, WiFi signal, modeling of perturbations of the magnetic field, etc. To be successful, advanced data fusion techniques should be used, such as particle filtering and the like, to take into account displacement constraints due to walls in the building, to manage several possible trajectories, and to deal with rather heterogeneous information (map, radio signals, sensor signals).

The main objective of this thesis is to design and tune localization algorithms that will be tested on platforms already available at CEA. Special attention is paid to particle smoothing and particle MCMC algorithms, to exploit some very precise information available at special time instants, e.g. when the user is clearly localized near a landmark point.

BIPOP Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Schneider Electric : CIFRE PhD thesis of Narendra Akadkhar (end of contract 31/12/2015).
- ANSYS France : CIFRE PhD thesis of Mounia Haddouni (end of contract 01/05/2015).
- ADEPT Technology : CIFRE PhD thesis of Saed AlHomsi (end of contract 31/12/2015).
- Aldebaran : CIFRE PhD thesis of Jory Lafaye (end of contract 30/06/2015).

CAGIRE Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Collaborative research contract with EDF: "Nouveau modèle de turbulence Haut-Bas Reynolds avec prise en compte de la thermique active ou passive. (New high-low Reynolds number turbulence model accounting for active or passive heat transfer)" associated with the PhD thesis of J.-F. Wald.

8.2. Bilateral Grants with Industry

PhD grant (CIFRE) of J.-F. Wald, EDF, in progress.

<p style="text-align:center; color:red">CARDAMOM Team</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Participant: Pietro Marco Congedo [Corresponding member].

Several contracts have been realized:

- SAFRAN-HERAKLES, 20Keuros for the in-situ evaluation of the Cut-ANOVA and RobUQ codes.
- EXOES, 8 KEuros, for the analysis of the performances of the EVE engine, produced by EXOES.
- CNES, 15 KEuros, for the robust analysis of the DEBRISK code.

<p align="center" style="color:red">COMMANDS Project-Team</p>

8. Bilateral Contracts and Grants with Industry

8.1. Transportation

8.1.1. IFPEN

In the framework of the PhD thesis of F.Bleuse, 'Optimal control and robustness for rechargeable hybrid vehicles'. The study is focused on the so-called parallel architecture, with both the thermal and electric engines able to move the vehicle. The main axis is to optimize the use of the thermal engine.

8.1.2. Safety Line

(a startup in aeronautics), research and transfer contract, optimization of fuel consumption for civil planes. A first part is devoted to the identification of the aerodynamic and thrust characteristics of the plane, using recorded flight data. A second part is optimizing the fuel consumption during the climb phase.

CQFD Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Airbus*

Participants: Benoîte de Saporta, François Dufour, Christophe Nivot.

We are interested in the optimization of a launcher integration process. It comprises several steps from the production of the subassemblies to the final launch. The four subassemblies go through various types of operations such as preparation, integration, control and storage. These operations are split up into three workshops. Due to possible breakdowns or staff issues, the time spent in each workshop is supposed random. So is the time needed to deliver the subassemblies, for similar reasons including e.g. shipping delays. We also have to deal with constraints related to the architecture of the assembly process itself. Indeed, we have to take into account waiting policies between workshops. The workshops may work in parallel but can be blocked if their output is not transferred to the next workshop in line. Storage capacity of output products is limited.

Our goal is finding the best rates of delivery of the subassemblies, the best choice of architecture (regarding stock capacities) and the best times when to stop and restart the workshops to be able to carry out twelve launches a year according to a predetermined schedule at minimal cost. To solve this problem, we choose a mathematical model particularly suitable for optimization with randomness: Markov decision processes (MDPs).

We have implemented a numerical simulator of the process based on the MDP model. It provides the fullest information possible on the process at any time. The simulator has first been validated with deterministic histories. Random histories have then been run with exponentially distributed delivery times for the subassemblies and several families of random laws for the time spent in each workshop. Using Monte Carlo simulations, we obtain the distribution of the launch times. Preliminary optimization results allow choosing stock capacities and delivery rates that satisfy the launch schedule.

In this context, the PhD Thesis of Christophe Nivot (2013-2016) is funded by Chaire Inria-Astrium-EADS IW-Conseil régional d'Aquitaine.

8.1.2. *Thales Optronique*

Participants: Benoîte de Saporta, François Dufour, Alizée Geeraert.

Integrated maintenance, failure intensity, optimisation.

As part of optimizing the reliability, Thales Optronics includes systems that examine the state of their equipment. This function is performed by HUMS (Health Unit Monitoring Systems). The collaboration is the subject of the PhD of Alize Geeraert (CIFRE). The aim of this thesis is to implement in the HUMS a program based on observations that can determine the state of the system, optimize maintenance operations and evaluate the failure risk of a mission.

8.1.3. *DCNS*

Participants: Huilong Zhang, Jonatha Anselmi, François Dufour, Dann Laneuville.

This contract is with DCNS, a French industrial group specialized in naval defense and energy. In particular, DCNS designs and builds submarines and surface combatants, develops associated systems and infrastructure, and offers a full range of services to naval bases and shipyards, together with a focus into marine renewable energy. The main objective is to have robust algorithms able to build an accurate picture of the objects that are around a submarine by only using "passive sonar" information. This means that no information is transmitted by the submarine, which just listens to acustic waves coming in, to the target. We estimate the position and the velocity of moving targets through noisy observations and a Kalman-type filter. Estimates become accurate depending on the type and the number of maneuvers done by the submarine. Our goal is to combine the filter that is currently used in DCNS with a Markov decision process. This provides a systematic framework to compute the best sequence of submarine maneuvers that allows the system to determine, as soon as possible, accurate target position and velocity. The current technological transfer to DCNS stands in a stochastic optimization framework developed in Matlab that operates under the hypothesis that the target follows a uniform linear motion with constant velocity or zero acceleration. The case where targets move in a more complex manner gives concrete perspectives for further transfers to DCNS.

<p align="center" style="color:red">DEFI Project-Team</p>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Contract with EDF R&D on non destructive testing of concrete materials (in the framework of the PhD thesis of Lorenzo Audibert, defended in 2015)

- Contract with EDF R&D on data assimilation for temprature estimates in nuclear reactors (in the framework of the PhD thesis of Thibault Mercier, defended in 2015)

- A CIFRE PhD thesis started in January 2015 with Dassault Aviations. The student is M. Aloïs Bissuel who is working on "linearized Navier-Stokes equations for optimization, fluttering and aeroacoustic".

- A CIFRE PhD thesis started in December 2015 with Safran Tech. The student is Mrs Perle Geoffroy who is working on "topology optimization by the homogenization method in the context of additive manufacturing".

7.2. Bilateral Grants with Industry

- The RODIN projet finished in September 2015. RODIN is the acronym of "Robust structural Optimization for Design in INdustry". 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 Sud-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. The software editor ESI is going to isse a commercial software in 2016. A sequel for RODIN is planned with a possible start in 2016.

- 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 nonaparticles 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.

- Electormagnetic 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.

- FUI project Saxsize. This three years project started in October 2015 and involves Xenocs (coordinator), Inria (DEFI), Pyxalis, Cordouan and CEA. It is a followup of Saxsise where a focus is put on SAXS imaging of nanoparticles powders.

DISCO Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

A collaboration with SAGEM Défense Sécurité on the robust stabilization of the lines of sight for pointing systems is developed through the PhD thesis of G. Rance (CIFRE).

A CIFRE PhD with Renault is currently undergoing in collaboration with Univ. d'Orleans (Nicoleta Stroe as PhD student).

<p align="center">**DOLPHIN Project-Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Intel (2015-2016) Bilateral academic and research partnarship between Université Lille 1 and Intel. In this context, Intel will provide Lille 1 with technical support help for the dissemination of its activities related to High Performance Computing.
- Strat-Logic (2012-2015): the objective of this CIFRE contract is the optimization of economic decisions in a competitive business management simulator (Phd of S. Dufourny).
- Vekia (2012-2015): the goal of the CIFRE project is to develop an efficient and generic software for employee scheduling in retail (Phd of M. Gérard).
- PIXEO (2014-2018): the objective of this bilateral project is the predictive models and knowledge extraction for insurance web comparator.
- Normand (2014-2015]: the objective of this contract is the modelling of a dynamic multi-objective scheduling problem in the medical analysis.
- Beckman (2015-2018]: the goal of this contract concerns the strategic and operational planning medical laboratories.

8.2. Bilateral Grants with Industry

- Intel 2015-2016 Bilateral grant with Intel. Intel has supported with a budget equivalent to 25K€ the acquisition of a cluster of 2 multi-core servers and 8 Intel Xeon Phi coprocessors. The objective is to develop research and teaching on multi and many-core computing on coprocessors.

ECUADOR Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Ecuador and Lemma share the results of Gautier Brèthes' thesis, which is partly supported by Lemma, the other part being supported by a PACA region fellowship.

- Ecuador and Lemma have a bilateral contract to share the results of Stephen Wornom, Lemma engineer provided to Inria and hosted by Inria under a Inria-Lemma contract.

- Ecuador and EDF have a bilateral contract on AD of the hydrology code "Mascaret". The correspondent on the Ecuador side is Valérie Pascual.

GAMMA3 Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

- Dassault Aviation, *Extraction de la topologie et simplification des détails géométriques*, P. Laug et H. Borouchaki, 66 k-euros, 2013-2015.

GECO Project-Team (section vide)

<p align="center">**GEOSTAT Project-Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Geostat has been granted in 2015 a Carnot-Inria contact to fund a 1 year engineer to develop a prototype of a speech emotion detection system. This contact, led by K. Daoudi, is in collaboration with the start-up BatVoice which targets the commercialization of affect-interactive digital systems.

- Geostat has set up an industrial contract with LECTRA Company, on the development of nonlinear signal processing tools for analysis signals acquired from turbines.

- DGT Inria has funded a Proof of Concept on heartbeat analysis with IHU LIRYC.

- Patent: Geostat is in the process of depositing a patent on hearbeat signal analysis with the help of Inria Transfer and the *Cabinet Netter*.

<center>**I4S Project-Team**</center>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. PhD CIFRE with EDF
Participants: Nassif Berrabah, Qinghua Zhang.

A joint PhD project between Inria and EDF (Electricité de France) has been started since December 2014. The purpose of this study is to develop methods for the monitoring of electrical instruments in power stations, in order to prevent failures caused by aging or accidental events. This project is funded by EDF and by the ANRT agency for three years.

8.1.2. Contracts with SVS
Participants: Laurent Mevel, Michael Doehler.

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 .

In 2014, the damage detection toolbox has been launched http://www.svibs.com/products/ ARTeMIS_Modal_Features/Damage_Detection.aspx.

In 2015, SVS and Inria have earned an Innobooster grant to help transfer algorithms in 2016 Artemis Extractor Pro.

8.1.3. Contracts with A3IP
Participant: Vincent Le Cam.

A licensing work has been initialized at IFSTTAR in order to sold some licenses of PEGASE 2 to companies who would like to use, modify, extend and sell the functions in the Structural Health Monitoring world. Separate and non-exclusive licenses will be regarded to:
- a) sell the PEGASE 2 devices : mother and daughter boards
- b) sell the PEGASE 2 Supervisor

8.1.4. Contract with SNCF : DEMETER
Participants: Vincent Le Cam, Mathieu Le Pen.

Deployment of a set of PEGASE platform for SNCF: SNCF has just signed a contract in view of instrumenting 2 railways sites where the needs of wireless and smart sensors has been expressed. The overall objective is to evaluate the contribution of intelligent and autonomous sensors in rail uses-boxes. I4S next contribution will mainly focus on data processing and algorithms implementation.

8.1.5. Collaboration with SNCF
Participant: Jean Dumoulin.

SNCF as contacted us to assess the thermal monitoring of some of their railways walls.

8.1.6. Contract with GDF
Participants: Vincent Le Cam, Mathieu Le Pen.

GDF (national french Gaz company) has signed a wide contract with IFSTTAR relative to many items in Wireless Sensors Networks. One of the items will be prototyped on PEGASE 2 platform and consists in finding an accurate solution for WSN synchronization without GPS source and for an autonomy of 10 years. One of the identified solution will be prototyped on PEGASE 2 as wireless and generic development platform and as it offers an accurate 100 nanoseconds absolute time reference.

8.1.7. *Collaboration with SIEMENS : NEOVAL Rennes*

Participant: Jean Dumoulin.

Since 2012, a work has been initiated for thermal studies for SIEMENS about subway infrastructures. 2013 was dedicated to the study of thermal instrumentation of subway. 2014 was focused on the instrumentation of a rail mockup in Nantes.

INOCS Team

5. Bilateral Contracts and Grants with Industry

5.1. Bilateral Contracts with Industry

- Industrial contract with EDF, Bilevel models for tariff setting problems in the energy field (2010-2011; 2012-2015)
- Industrial contract with Coliweb, Load charge assignent for freight deliveries (2015-2016)

5.2. Bilateral Grants with Industry

- Gaspard Monge Program for Optimisation and operationnal research, Design and Pricing of Electricity Services in a Competitive Environment (2015-2018)
- Gaspard Monge Program for Optimisation and Operationnal Research, BENMIP A Generic Benders Decomposition based (Mixed) Integer Programming Solver, (2015-2016)

IPSO Project-Team (section vide)

MATHERIALS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contracts and grants with Industry

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

MATHRISK Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Consortium PREMIA, Natixis - Inria
- Consortium PREMIA, Crédit Agricole CIB - Inria

8.2. Bilateral Grants with Industry

- Chaire X-ENPC-UPMC-Société Générale "Financial Risks" of the Risk fondation : A. Alfonsi, B. Jourdain, B. Lapeyre
- A. Sulem: Research Grant for the project "*Stochastic Control of Systemic Risk*", awarded by the scientific council and Professional Fellows of Institut Europlace de Finance (EIF) and Labex Louis Bachelier with A. Minca (Cornell University).
- R. Elie with Arthur Charpentier:

  Chaire with COVEA on digital impact in actuarial activities (2015-2018).

Maxplus Team

8. Bilateral Contracts and Grants with Industry

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

- Modélisation et Résolution des problèmes de très grande taille dans les applications du yield management au réseau des télécommunications mobiles: CRE en cours avec Orange Labs (responsable du suivi Orange Labs: Mustapha Bouhtou).

<p align="center" style="color:red">**MCTAO Project-Team**</p>

7. Bilateral Contracts and Grants with Industry

7.1. Thales Alenia Space - Inria

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

This contract started October, 2012 and ended September, 2015. It partially supported Helen Heninger's PhD.

The goal was 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).

7.2. CNES - Inria - UMB

"Poussée faible et moyennation".
CNES number: 130777/00.

This three year contract started in 2014. It involves CNES and McTAO (both the Inria and the Université de Bourgogne parts). It concerns averaging techniques in orbit transfers around the earth while taking into acount many perturbation of the main force (gravity for the earth considered as circular). The objective is to validate numerically and theoretically the approximations made by using averaging, and to propose methods that refine the approximation.

MEMPHIS Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

We intend to pursue our partnership with Valeol, a wind turbine contractor in Aquitaine. Valeol poses simulation problems that cannot be addressed with standard tools. We have developed for them simplified PDE models for design in the frame of a industry funded PhD (CIFRE). We are currently adapting octree and Chimera approaches to the design of aerodynamic appendices to improve performance of existing installations. This is done in the frame of yet another CIFRE PhD thesis and the corresponding research contract. Moreover, thanks to this technology readiness, Valeol could join for the first time an H2020 research project, AEROGUST, that we are promoting with several academic and industrial institutions across Europe.

We continue to deploy our effort in flow control and drag reduction for ground vehicles. After a fruitful collaboration with Renault, we are in the phase of negotiating a new collaboration. A new collaboration is starting with Valeo to optimize car cooling devices. DNS simulations are performed and compared to the industrial results obtained with URANS and LES methods and an EU network about this subject is going to be proposed.

MEPHYSTO Team (section vide)

MISTIS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

DGArapid WIFUZ (2015-2017). F. Forbes is the principal investigator for MISTIS of the 2 year project WIFUZ on *WIreless multi sensors FUSion*. The project is supported by DGA and led by the ACOEM company http://www.acoemgroup.fr/ and involves another company, the HIKOB startup, http://www.hikob.com/. The objective is to develop a prototype for surveillance and monitoring that is able to combine multi sensor data coming from acoustic sensors (microphones or antennas) and optical sensors (infrared cameras) and to distribute the processing to multiple algorithmic blocs. The financial support for MISTIS is of 122,4 keuros for a project of a total cost of 375 keuros.

CIFRE PhD with SCHNEIDER (2015-2018). F. Forbes and S. Girard are the advisors of a starting CIFRE PhD (T. Rahier) with Schneider Electric. The other advisor is S. Marié from Schneider Electric. The goal is to develop specific data mining techniques able to merge and to take advantage of both structured and unstructured (meta)data collected by a wide variety of Schneider Electric sensors to improve the quality of insights that can be produced. The total financial support for MISTIS will be of 165 keuros.

PhD contract with EDF (2015-2018). S. Girard is the advisor of a starting PhD (A. Clement) with EDF. The goal is to investigate sensitivity analysis and extrapolation limits in Extreme value theory with application to river flows analysis.

8.2. Bilateral Grants with Industry

UAC XEROX INDIA (2014-2017). F. Forbes is co-principal investigator with R. Horaud (PERCEPTION) of a Xerox Foundation University Affairs Committee (UAC) collaborative grant *Advanced and Scalable Graph Signal Processing Techniques*, in collaboration with Arijit Biswas and Anirban Mondal, research scientists at Xerox Research Center India (XRCI) Bangalore. This collaboration is an opportunity to launch a joint research program with a Xerox Indian team. We plan to investigate robust mixture models and techniques to deal with graphical data. Xerox Foundation funding: 80 keuros.

<center>**MODAL Project-Team**</center>

8. Bilateral Contracts and Grants with Industry

8.1. Genoscreen

Participant: Guillemette Marot.

Subject: Genoscreen is a company which offers innovative solutions in genomics and molecular biology. New technologies such as high throughput sequencing have raised statistical questions to analyse metagenomic data. Formation and expertise has been provided to this company to help them analyse this new type of data.

8.2. Bilateral Contracts with Industry

Participant: Julien Jacques.

ORANGE Labs : contrat de recherche pour l'extraction de connaissances dans de gros volumes de données hétérogènes pour la gestion automatique des réseaux radio, en lien avec le financement de la thèse CIFRE de Yosra Ben Slimen.

8.3. 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 semisupervised classification involving (1) a small number of individuals comparing to the numbers of variables, (2) heterogeneous variables, typically categorical and continous variables and (3) potentially highly correlated variables. A PhD CIFRE grant started on May 2011 on this topic and has finished on July 8th 2015. It has led also the the CorReg package, available on the CRAN (https://cran.r-project.org/web/packages/CorReg/index.html) and referenced on the Inria BIL application

8.4. Auchan

Participants: Christophe Biernacki, Serge Iovleff, Vincent Vandewalle.

Subject: Groupe Auchan SA is a French international retail group and multinational corporation headquartered in Croix. It is one of the world's principal distribution groups with a presence in 12 countries and 269,000 employees. The aim of the two months contracts (It started late 2014 and finished early in 2015) between Auchan and Modal is to identify human factors which significantly impact the economical results of the company. From a scientific point of view, it corresponds to regression studies (simple and mixture regression) with missing data and correlated data.

8.5. PIXEO

Participants: Christophe Biernacki, Anne Lise Bedenel.

Subject: PIXEO is a company allowing online comparisons of insurances. A PhD thesis for optimizing the workflow related to this activity started in June 2015, with co-supervisision of Laetitia Jourdan of the Dolphin Inria team. The title of the thesis is "Supervised and unsupervised classification with descriptors evolving in time. Application to online comparisons of insurances." Before the beginning of the thesis, a preliminary contract has been established since October 2014 until May 2015, in order to prepare precisely the research subject. It was a work in collaboration with two members of the Dolphin Inria team (Laetitia Jourdan and Marie-Eléonore Marmion).

8.6. Cylande

Participants: Christophe Biernacki, Etienne Goffinet, Vincent Kubicki, Vincent Vandewalle.

Subject: Cylande is a company which provides software solutions for retail. The aim of the contract is to provide statistical tools for optimal management delivery. The proposed solution relies on density estimation and also on model-based clustering, both for mixed data (count data, categorical data, continuous data). It should involved the MixtComp software (referenced on the Inria BIL application) developed by the team. It is a 12 months contract, started on October 1st 2015.

MOKAPLAN Project-Team (section vide)

NACHOS Project-Team (section vide)

NANO-D Project-Team (section vide)

NECS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. ALSTOM

Contract with ALSTOM in the framework of Inria/ALSTOM joint laboratory, and CIFRE PhD grant of Simon Gerwig. This thesis explores collaborative and reconfigurable resilient control design of hydroelectric power plants; current work is on improving performance of a hydro-electric power-plant outside its design operation conditions, by cancellation of oscillations that occur in such operation range.

8.1.2. INRIX

A collaboration with INRIX has concerned floating car data, namely data about cars velocity collected from mobile devices, that are useful to complement density and velocity measurements from road sensors.

<div align="center" style="color:red">**NON-A Project-Team**</div>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- a PhD CIFRE with SAGEM (France), supervisors are Alban Quadrat and Hugues Mounier

POEMS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Contract POEMS-DGA
Participants: Anne-Sophie Bonnet-Ben Dhia, Sonia Fliss, Patrick Joly.

Start : 09/01/2011, End : 12/31/2015. Administrator : ENSTA.
This contract is about guided waves 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.

Contract POEMS-DGA
Participants: Eric Lunéville, Marc Lenoir, Séphanie Chaillat, Nicolas Kielbasiewicz, Nicolas Salles.

Start : 2015, End : 2018. Administrator : ENSTA.
This contract is in partnership with François Alouges and Matthieu Aussal (CMAP, Ecole Polytechnique) and concerns the improvement of Boundary Element Methods for wave propagation problems.

Contract POEMS-CEA-LIST
Participants: Marc Bonnet, Laure Pesudo.

Start : 12/01/2014, End : 11/31/2017. Administrator : CNRS.
This contract is about the coupling between high frequency methods and integral equations.

Contract POEMS-SHELL
Participants: Stéphanie Chaillat, Patrick Ciarlet, Luca Desiderio.

Start : 10/01/2013, End : 09/31/2016. Administrator : CNRS.
This contract is about fast direct solvers to simulate seismic wave propagation in complex media.

Contract POEMS-EDF
Participants: Stéphanie Chaillat, Marc Bonnet, Zouhair Adnani.

Start : 12/01/2014, End : 11/31/2017. Administrator : CNRS.
This contract is about fast solvers to simulate soil-structure interactions.

QUANTIC Project-Team (section vide)

RAPSODI Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Roberta Tittarelli was in PhD under the co-direction of Emmanuel Creusé (with S. Nicaise, LAMAV Valenciennes and F. Piriou, L2EP Lille 1) on an EDF R&D Support (CIFRE) from October 2012 to October 2015. She worked on a posteriori error estimators for problems arising in low-frequency electromagnetics. She developped residual estimators for unsteady problems, as well as equilibrated ones for harmonic formulations (see section 6.2 for new results about this last point). Its contributions have been implemented in the EDF R&D code "Carmel-3D", and allow to improve the simulations by providing an efficient tool driving the mesh refinement algorithms. She is now on an ATER support at Lille 1 University and and the PhD's defense should occur before the middle of 2016.

C. Cancès supervises the PhD Thesis of Nicolas Peton at IFPEN since October 15, 2015. The bilateral contract should be signed in the forthcoming weeks.

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REALOPT Project-Team

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8. Bilateral Contracts and Grants with Industry

8.1. Contract with EDF on robust maintenance planning

Our project with EDF concerns the optimization of the long term energy production planning, allowing for nuclear power plants maintenance. The challenges are to handle the large-scale instance of a five year planning and to handle the stochastic aspects of the problem: the stochastic variation of the electricity demand, the production capacity and the duration of maintenance period. The key decisions to be optimized are the dates of outages (for maintenance) and the level refuelling that determines the production of the year to come. We previously developed a column generation approach based on extended formulation which enables to solve within a few minutes a deterministic instance of the problem, which is within the time frame of the operational tools currently used by EDF. We now investigate stochastic and robust versions of the problem, where the duration of maintenance operations and the power demand are uncertain. Our approaches shall be evaluated on real life instances within a rolling horizon framework.

8.2. Collaboration with ERTUS on phytosanitary treatment planning

In planning winary operations (most importantly phytosanitary treatments on the wine tree) under wheather forcast uncertainty, one searches for solutions that remain feasible and "cheap" in case of perturbation in the data. We consider the planning and scheduling of the operations that arise over a one-year horizon. More precisely, the operations to be sheduled include tasks related to soil care, or grape tree care: cutting, line building, thinning out leaves, ..., and chemical treatments. The latter are a main focus of our study since one of the principal goals of better planning is to reduce the amount of chemical treatments by selecting the appropriate products and schemes, but also by spacing out treatements while guarantying a desease free vineyard with some confidence. Each of the scheduled tasks requires its own resource, so the planning also triggers equipement and raw products selection decisions. The objective is to minimize both equipment and product costs augmented by an evaluation of the hazard of chemical product use. The planning should be "robust" to seasonal variations on the proper time frame for scheduling tasks.

8.3. Collaboration with B-Travel on a yield management problem

Through the PhD thesis of Martin Bué (in collaboration with inria team Dolphin), we are now working with society B-Travel on pricing and yield management. The goal is to find the best prices and incentives in the context of professional travel. The techniques used are based on network-flow formulations and mathematical programming.

8.4. Collaboration with Asys on an employee-scheduling problem

Through the PhD thesis of Matthieu Gérard, we have investigated a very rich version of employee-scheduling problem. We have designed an efficient algorithm for computing the best shift for each employee, based on dynamic programming. This method is used in a greedy algorithm to find solutions in a faster manner, and in a branch-and-price method to prove the optimality of the solution.

8.5. Collaboration with Renault S.A. on truck loading problem

The goal of this one year industrial contrat was to analyze the algorithmic solutions used by Renault S.A. for packing items into trucks. The outcome of the contract was a report on their approach and how hints to improve it.

8.6. Collaboration with St-Gobain Recherche on glass cutting

Through the PhD of Quentin Viaud, we study a hard glass-cutting problem. The objective is to minimize the quantity of trim loss when rectangular pieces are cut from large rectangles. This first study has shown that our methodologies are able to cope with this problem for medium-size instances. Solving the problem with large instances is a scientific challenge that we will address in the a follow-up contract.

7. Bilateral Contracts and Grants with Industry

7.1. Contract with SNECMA

Participants: Gilles Celeux, Florence Ducros, Patrick Pamphile.

SELECT has a contract with Nexter regarding modeling the reliability of vehicles.

SELECT works with the CEA on statistical modeling for battery state of charge.

Contract with AirNormand: Mixtures of experts for PM10 forecasting, and stability of kriging procedures.

Contract with EDF: Curve clustering and disaggregation of the load forecasting

SEQUEL Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Jeremie Mary got a contract with Nuukik on the use of seasonality to improve recommender systems for e-commerce. This work won the price of the "Best data analysis" at "La nuit du commerce connecté" - http://www.retail-network.fr", 1500 participants, 80 projects in 5 categories.

8.2. Bilateral Grants with Industry

- Romain Warlop obtains a CIFRE grant with the start-up Fifty-Five and started his PhD in July under the supervision of Alessandro Lazaric, Jérémie Mary and Philippe Preux. The PhD is on the use of tensor and bandits techniques for recommender systems with a special focus on the cold start problem, and the non-stationarity of the environment.

- Nicolas Carrara obtains a CIFRE grant with Orange Labs and started his PhD in October under the supervision of Olivier Pietquin. The PhD topic is on transfer learning for fast adaption of spoken dialogue systems.

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SIERRA Project-Team

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8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Microsoft Research: "Structured Large-Scale Machine Learning". Machine learning is now ubiquitous in industry, science, engineering, and personal life. While early successes were obtained by applying off-the-shelf techniques, there are two main challenges faced by machine learning in the "big data" era: structure and scale. The project proposes to explore three axes, from theoretical, algorithmic and practical perspectives: (1) large-scale convex optimization, (2) large-scale combinatorial optimization and (3) sequential decision making for structured data. The project involves two Inria sites (Paris and Grenoble) and four MSR sites (Cambridge, New England, Redmond, New York). Project website: http://www.msr-inria.fr/projects/structured-large-scale-machine-learning/.

8.2. Bilateral Grants with Industry

- A. d'Aspremont, IdR EMMA, Euroclear – Institut Louis Bachelier.
- A. d'Aspremont, IBM Faculty Award.
- A. d'Aspremont and F. Bach, IdR AXA "Machine Learning", chaire Havas-ILB, Economie des Nouvelles Données.
- A. d'Aspremont and F. Bach, Comité de pilotage, chaire Havas – Dauphine "Economie des nouvelles données".
- S. Lacoste-Julien (with J. Sivic and I. Laptev in Willow project-team), Google Research Award "Structured Learning from Video and Natural Language".

SPHINX Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

In June 2015, Boris Caudron began a CIFRE thesis with Thales under the academic supervision of Xavier Antoine. The accompanying support contract, about 45 000 euros, will be signed in January 2016.

<p style="text-align:center; color:red;">**TAO Project-Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- **Thales Research & Technology** 2014-2017 (30 kEuros), related to Nacim Belkhir's CIFRE PhD
  Coordinator: Marc Schoenauer
  Participants: Johann Dréo, Pierre Savéant, Nacim Belkhir

- **Orange** 2013-2016 (30 kEuros), related to Robin Allesiardo's CIFRE PhD
  Coordinator: Michèle Sebag
  Participants: Raphael Feraud, Robin Allesiardo

- **Réseau Transport d'Electricité** 2015-2018 (30 kEuros), related to Benjamin Donnot's CIFRE PhD
  Coordinator: Olivier Teytaud
  Participants: Benjamin Donnot, Antoine Marot

- **Augure (SME)** 2013-2015 (150 kEuros). MoDyRum (Modélisation Dynamique d'un Réseau Médiatique), related to Marco Bressan's postdoc SME Augure)
  Coordinator: Michèle Sebag
  Participants: Philippe Caillou, Cyril Furtlehner, Marco Bressan

TOSCA Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- TOSCA Sophia is involved in a Cifre convention with Koris International. M. Bossy supervises M. Bonelli's Ph.D. thesis.

- TOSCA Nancy had a bilateral contract coordinated by M. Deaconu with the SME Alphability on financial risk measures with applications in portfolio management.

- M. Deaconu is involved in a bilateral contract with Venathec. She is supervising, with E. Vincent (EPI MULTISPEECH), the Ph.D. thesis of B. Dumortier on the acoustic control of wind farms noise.

ABS Project-Team (section vide)

<p style="text-align:center; color:red">AIRSEA Team</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral 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 ARTELIA Group: funding for the PhD thesis of M.P. Daou (CIFRE)

- A 1-year contract with NOVELTIS on the thematic "Développement de démonstrateurs avec AGRIF": see 6.1

- A 1-year contract with IFREMER on the thematic "Evolution de la librairie de raffinement de maillage en Fortran (AGRIF) : amélioration de la prise en compte du trait de côte et des frontiéres ouvertes en contexte paralléle MPI/OpenMP" : see 6.1

AMIB Project-Team (section vide)

ANGE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- A research contract with SAUR (company managing water supplies) was negotiated in 2015. It deals with the modelling and the simulation of saline stratification in a dam reservoir of the Vilaine river in Brittany.
- ANGE appealed to SciWorks Technologies to transfer Freshkiss3D in a user-friendly tool for a larger diffusion to potential industrial partners. The joint development will result in an advanced easy-to-use software.

8.2. Bilateral Grants with Industry

P. Ung's PhD was funded by EDF, CNRS, AMIES (French agency for mathematics in interaction with companies and the society) and ANTEA–group and ended in late 2015. A collaboration with EDF for a new PhD grant in 2016 is currently under consideration.

ARAMIS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Air-Liquide Medical Systems

Participants: Mario Chavez [Correspondant], Xavier Navarro.

Project title: Real-time characterisation of respiratory states from EEG

Founded in 2014

Amount: 370 K€

Coordinator: Thomas Similowski

Other partners: UPMC, Inserm UMR 1158

Abstract: The project aims at developing a real-time brain computer interface (BCI) for the monitoring of respiratory states from scalp EEG data of healthy volunteers and patients, recorded at the laboratory, hospital ward, operating room or intensive care units..

ASCLEPIOS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. CIFRE PhD Fellowships

7.1.1.1. Neurelec/Oticon Medical

The work of Thomas Demarcy, *Segmentation and anatomic variability of the cochlea and other temporal bone structures from medical images*, is supported by a PhD fellowship from the Neurelec/Oticon Medical company.

7.1.2. Inria - Mauna Kea Technologies I-Lab SIWA

Participants: Nicholas Ayache [correspondent], Xavier Pennec, Marzieh Kohandani Tafreshi, Rémi Cuingnet.

This I-lab involves the Mauna Kea Technologies company.

The first focus of this I-lab is to develop efficient and friendly content-based image retrieval (CBIR) tools to help users make a diagnosis. The second focus is on image registration to provide near real-time and robust image registration tools built on GPU implementations for image stabilization and super-resolution since it is a critical method for the smart atlas.

For more information, see this link[0].

7.1.3. Microsoft Research

Microsoft Research is funding through the Inria-Microsoft joint lab the projects "4D Cardiac MR Images"[0] and "Medilearn"[0] which aim at analyzing large databases of cardiac images to help the diagnosis of cardiac diseases and planning of therapy. This project involves A. Crimisi from MSR and partially funds the PhDs of Loic Le Folgoc and Jan Margeta, as well as the post doctoral stay of Hervé Lombaert.

7.1.4. Spin-off company Therapixel

Therapixel[0] is a spin-off of the Asclepios (Inria Sophia Antipolis) and Parietal (Inria Saclay) project teams founded in 2013. Therapixel makes surgical information systems. It relies on depth sensing, advanced software processing and innovative user interfaces to provide touchless control of the computer. This technology allows for a direct control of the computer, which sterility constraints made impractical in the past. In 2015, Therapixel obtained the CE marking of its product on touchless visualization of medical images.

7.1.5. Other contracts

Contracts with Philips and Siemens are described in our previous activity reports.

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[0]https://lisa.sophia.inria.fr/siwa-loasis-numerique-dinria-et-de-mauna-kea-706.html
[0]http://www.msr-inria.fr/projects/4d-cardiac-mr-images
[0]http://www.msr-inria.fr/projects/medilearn
[0]http://www.therapixel.com/

<p style="text-align:center">**ATHENA Project-Team**</p>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

- The Olea Medical company from La Ciotat (FR) funds 50% of the PhD of Marco Pizzolato, supervised by Rachid Deriche, which is funded by the PACA Region for the remaining 50%.
- The BESA company (Brain Electrical Source Analysis) from Germany funds 50% of the PhD of Christos Papageorgakis, co-supervised by Maureen Clerc (Athena) and Juliette Leblond (Apics), which is funded by the PACA Region for the remaining 50%.
- The Neurelec company (Cochlear Implants) has obtained a CIFRE PhD funding for Kai Dang, supervised by Maureen Clerc.

BEAGLE Project-Team (section vide)

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

T. Bastogne, full Professor at Université de Lorraine and BIGS member is head of the startup Cybernano that provides computational solutions for biopharma and nano-medicine. http://www.cybernano.eu/

<p style="color:red; text-align:center;">**BIOCORE Project-Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

BioEnTech: the contract with the BioEnTech start-up is aiming at developing new functionalities for ODIN in order to improve the advanced monitoring and control of industrial anaerobic digesters.

BONSAI Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

The PhD thesis of Lea Siegwald is funded by a CIFRE contract with the biotechnology company Gene Diffusion.

CAPSID Project-Team (section vide)

CARMEN Team (section vide)

CASTOR Project-Team (section vide)

CLIME Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Clime is partner with IRSN (http://www.irsn.fr/), the French national institute for radioprotection and nuclear safety, for 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 an Inria innovation lab with the group SETH (Numtech http://www.numtech.fr/). 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.

COFFEE Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

The project has industrial collaborations with Total, GDFSuez EP and Storengy on oil and gas recovery and gas storage.

The collaboration with Andra is concerned with the modelling and the simulation of mass and heat exchanges between porous media and ventilation channels. It leads to consider porous medium equations and hydrodynamic systems, coupled through intricate boundary conditions. Clearly one of the difficulties relies on the multiphase nature of the flows (at least water and air are present). We identify relevant physical scales, typical of the flows under consideration in nuclear waste engineering. We start by dealing with quite simple geometries, in order to discuss properly the order of magnitude of the different phenomena, and to design suitable schemes

DEMAR Project-Team (section vide)

DRACULA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

The industrial connections of the Dracula team have been made through the "Modeling of the immune response" project. Contacts have been established with both large pharmaceutical companies (Sanofi-Pasteur and Merial) and SMEs (Altrabio and Cosmo). The current ANR PrediVac incorporates the two aforementioned SMEs and therefore strengthens the ties between Dracula and its industrial local ecosystem. Furthermore, the ties with the COSMO companies have been strenghened through a joint CIFR pHD (see below).

DYLISS Project-Team (section vide)

ERABLE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

From April 2013 to April 2015, N. Pisanti had a 60,000 euros + TVA grant from the private company Galileo Research srl for Scientific Counseling on "New technological Platform for Immunotherapy of cancers with synergic treatment".

FLUMINANCE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

7.1.1. Contrat CERSAT/IFREMER

Participants: Etienne Mémin, Valentin Resseguier.

duration 36 months. This partnership between Inria and Ifremer funds the PhD of Valentin Resseguier, which aims at studying image based data assimilation strategies for oceanic models incorporating random uncertainty terms. The goal targeted will consist in deriving appropriate stochastic version of oceanic model and on top of them to devise estimation procedures from noisy data to calibrate the associated subgrid models.

GALEN Project-Team (section vide)

GENSCALE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Empowered memory*
Participants: Charles Deltel, Dominique Lavenier.

The UPMEM company is currently developing new memory devices with embedded computing power. GenScale investigates how bioinformatics algorithms can benefit from these new types of memory (see section New Results).

8.2. Bilateral Grants with Industry

8.2.1. *Korilog: I-Lab KoriScale*
Participants: Sébastien Brillet, Erwan Drezen, Dominique Lavenier, Ivaylo Petrov.

In June 2013, GenScale and the Korilog Company created an Inria common structure research (I-LAB) called KoriScale. This is the outcome of a solid relationship, which has enabled the transfer of the PLAST software (bank to bank genomic sequence comparison) from GenScale to Korilog. The resulting commercial product (Klast) is now 5 to 10 times faster than the reference software (Blast). The main research axe of the I-LAB focuses on comparing huge genomic and metagenomic datasets. In June 2015, Korilog stopped its activity.

8.2.2. *Rapsodyn project*
Participants: Dominique Lavenier, Claire Lemaitre, Sebastien Letort, Pierre Peterlongo.

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 optimization of the rapeseed oil content and yield under low nitrogen input. GenScale is involved in the bioinformatics work package, in collaboration with Biogemma's bioinformatics team, to elaborate advanced tools dedicated to polymorphism.

7. Bilateral Contracts and Grants with Industry

7.1. BGene

Participants: Johannes Geiselmann, Hidde de Jong, Corinne Pinel.

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 appropriate 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). Corinne Pinel works part-time at BGene, and Johannes Geiselmann and Hidde de Jong are members of its scientific advisory board. For more information on BGene, see http://www.bgene-genetics.com/.

7.2. Genostar

Participants: Hidde de Jong, Michel Page, 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 5.1). 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 CEO of the company. For more information, see http://www.genostar.com.

LEMON Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Free surface hydraulics

The finite volume-based, SW2D computational code (see Software section) is used by Cereg Ingénierie and Enveo (Montpellier Lavérune location) on a regular basis to carry out flood risk assessment studies. The code is constantly being developed on a work-for-hire basis depending on the company needs. The developments mostly concern pre- and post-processing functionalities, as well as specific hydraulic modules.

8.1.2. Hydrodynamics of coastal lagoons with porosity models

A two-dimensional shallow water with depth-variable porosity has been developed. The depth-variable porosity allows the subgrid-scale variations of the topography and hydraulic connectivity to be accounted for. The governing equations are written in conservation form and solved using a finite volume scheme. This allows the CPU time of the computational code to be divided by 2 to 3 orders of magnitude. The model is currently being tested against in situ measurements in the Vaccarès system in collaboration with Tour du Valat.

8.2. Bilateral Grants with Industry

Antoine ROUSSEAU collaborates with ARTELIA in the framework of M-P Daou's PhD thesis (CIFRE).

LIFEWARE Project-Team (section vide)

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

We have signed a collaboration agreement with Clinique Pasteur (Toulouse), the 3rd private hospital in France in global activity and the 1st in cardiology, in particular with the motivation of performing research oriented towards the perspective of developing connected applications for the monitoring of cardiac pathologies.

MAGIQUE-3D Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contracts with TOTAL

- Depth Imaging Partnership (DIP)

  Period: 2014 May - 2019 April , Management: Inria Bordeaux Sud-Ouest, Amount: 120000 euros/year.

- Construction de milieux équivalents en vue de la simulation d'ondes élastiques harmoniques en milieux fortement hétérogènes par des méthodes DG

  Period: 2012 October - 2015 October, Management: Inria Bordeaux Sud-Ouest, Amount: 165000 euros

- Simulation de la propagation d'ondes élastiques et visco-élastiques en régime harmonique par des méthodes Galerkine discontinues d'ordre élevé en maillage non structuré adaptées au calcul haute-performance.

  Period: 2012 October - 2015 October, Management: Inria Bordeaux Sud-Ouest, Amount: 165000 euros

- Méthodes d'inversion sismique dans le domaine fréquentiel

  Period: 2014 October - 2017 December , Management: Inria Bordeaux Sud-Ouest, Amount: 180000 euros.

MAMBA Project-Team (section vide)

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

InSimo is a startup we created in January 2013, after two years of thinking, maturation and incubation. Its founding members were all former team members of the SHACRA team (our previous team): Jérémie Allard, Juan Pablo de la Plata Alcalde and Pierre Jean Bensoussan have joined the operation team, while Stéphane Cotin and Christian Duriez serve as scientific advisors. The business model of the company is based on the SOFA platform and its community to transfer state-of-the-art simulation technologies into commercially-supported software components that medical simulator vendors can integrate into their products. The goal is to foster the creation of a new generation of medical simulators, highly realistic, faster to develop, allowing a broader commercial offer and novel uses. InSimo participated to the 2012 OSEO / MESR national innovative technology company creation competition (Emergence category) and was selected as the best project in the Alsace region as well as one of the three projects highlighted at the national level. InSimo also won the HelpMeSee contract (in partnership with Moog and SenseGraphics) and entered in February 2013 into a 3-year development phase to build a first batch of 100 MSICS simulators.

In the context of the SOFA Consortium, the team is also in close collaborations with:

Altran : is a global leader in innovation and high-tech engineering consulting, Altran accompanies its clients in the creation and development of their new products and services. At the occasion of the "Journée Poster", several members of the team (Rosalie Plantefève, Bruno Marques Jaime Guevara and Christoph Paulus) presented their work.

Anatoscope: is a young start-up company created in 2015 by researchers, engineers and one surgeon. We develop a software solution to automatically build 3D digital avatars based on medical images of patients. The avatars allow biomechanical simulations of the real person.

TruPhysics: develops Industry 4.0 software solutions to support manufacturing companies in development and sales processes by using a real-time and high-resolution physics simulation. We provide software that enables developers and engineers to simulate control programs, physical properties, kinematics and behavior of industrial robots, machines and assemblies.

MNEMOSYNE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Contract with Algotech

Participants: Frédéric Alexandre, Ikram Chraibi Kaadoud, Nicolas Rougier, Thierry Viéville.

Algotech is a SME working in the domain of CADD software edition for electrical circuit diagram interpretation and design. Its activity is interesting for our team because they are also interested in the design, by learning, of perception (for diagram identification) and action aspects of loops (for diagram genesis) with the specificity of working at a small scale, considering the variety of items to be manipulated. This is consequently a very interesting benchmark for transfering our bio-inspired models to the domain of classical machine learning, as we have begun this year.

MODEMIC Project-Team (section vide)

Monc Team (section vide)

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

General Electric Healthcare: a 6 months (from february to july) contract to finalize the PhD work of T. Benseghir.

MYCENAE Project-Team (section vide)

NEUROMATHCOMP Project-Team (section vide)

NEUROSYS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. CertiViBE

Laurent Bougrain is a member of the steering committee of OpenViBE and CertiViBE.

CertiViBE, a medically certifiable core for OpenViBE, the software for Brain Computer Interfaces and Neuroscience research. It is a iLAB project between the Inria project-team Hybrid and Mensia Technologies SA (http://www.mensiatech.com/)

Founded in 2012, Mensia Technologies is a medical-device spin-off of Inria owning an exclusive worldwide license of the OpenViBE software for commercial applications. So far, OpenViBE has raised a lot of interest in the research community, especially on medical applications. However, OpenViBE being a research-software, it does not yet matches the requirements of medical devices in terms of stability, performance, documentation, as well as engineering processes in general, slowing down the transfer of OpenViBE-based medical research to the industry. Within the CertiViBE project, Inria and Mensia Technologies are putting their task forces and respective expertise together to deliver a certifiable core for the OpenViBE software. While the OpenViBE software will continue to be published as an Open Source software, the project will dramatically facilitate the transfer of the research made with OpenViBE as it will be built on ready-to-certify foundations, following the processes and normative regulation of medical devices development including risk analysis, quality assurance and medical device software development and maintenance.

NUMED Project-Team

5. Bilateral Contracts and Grants with Industry

5.1. Bilateral Contracts with Industry

- Industrial contract with Sanofi Pasteur (sept 2014 - march 2016)
- Four years framework contract with Servier (2014-2017)
- Industrial contract with Tiama (june 2015 - january 2016)

PARIETAL Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. The LearnClues Labcomm

The LearnClues LabComm has been granted in Oct, 2014, and the agreement was signed in Dec. 2015.

Statistical learning is a field of mathematics and computer science that enables the extraction of predictive models from data with weak signal to noise ratio. These techniques are behind the successes of Google or the progresses of automatic medical diagnostic. Combined with a knowledge of the field of application, they open the door to optimal decisions. Tinyclues is a start-up that applies statistical learning to e-commerce, adapting the marketing practice from customer databases. Parietal is an Inria research group that develops statistical learning for neurosciences and is the driving force behind the software tool "scikit-learn", that is a standard in statistical learning.

The goal of this proposed common lab is to transfer the expertise of Parietal on big data and to improve statistical learning techniques and implementation on distributed systems to open the door to faster analysis of very large datasets. Indeed, processing more data implies detecting smaller effects in the signals. Tinyclues already uses the tools developed par Parietal on the "cloud", and thus in distributed computing environments. The practical experience of Parietal enables us to plan substantial improvements to computational performance as well as to the amount of information extracted from big data.

From a strategical standpoint for Tinyclues, such progress are important to vary the number of domain scenarios that it can address, by analyzing jointly more data of a wider type, and to render fully automatic the data analysis platform that it is offering to its customers, replacing challenging tasks currently performed by experts. These developments are particularly important given that Tinyclues is developing at a very fast rate and is processing bigger and bigger datasets and an increasing number of different problems.

The project partners are:

- Parietal, Inria
- Tiny Clues

8.2. The Wendelin FUI project

The Wendelin project has been granted on December 3rd, 2014. It has been selected at the *Programme d'Investissements d'Avenir (PIA)* that supports "cloud computing et Big Data". It gives visibility and fosters the French technological big data sector, and in particular the scikit-learn library, the NoSQL "NEO" et the decentralized "SlapOS" cloud, three open-source software supported by the Systematic *pôle de compétitivité*.

Scikit-learn is a worldwide reference library for machine learning. Gaël Varoquaux, Olivier Grisel and Alexandre Gramfort have been major players in the design of the library and Scikit-learn has then been supported by the growing scientific Python community. It is currently used by major internet companies as well as dynamic start-ups, including Google, Airbnb, Spotify, Evernote, AWeber, TinyClues; it wins more than half of the data science "Kaggle" competitions. Scikit-learn makes it possible to predict future outcomes given a training data, and thus to optimize company decisions. Almost 1 million euros will be invested to improve the algorithmic core of scikit-learn through the Wendelin project thanks to the Inria, ENS and Institut Mines Télécom teams. In particular, scikit-learn will be extended in order to ease online prediction and to include recent stochastic gradient algorithms.

NEO is the native NoSQL base of the Python language. It was initially designed by Nexedi and is currently used and embedded in the main software of company information systems. More than one million euros will be invested into NEO, so that scikit-learn can process within 10 years (out-of-core) data of 1 exabyte size.

Paris13 university and the Mines Télécom institute will extend the SlapOS distributed mesh cloud to deploy Wendelin in *Big Data as a Service* (BDaaS) mode, to achieve the interoperability between the Grid5000 and Teralab infrastructures and to extend the cloud toward smart sensor systems.

The combination of scikit-learn, NEO and SlapOS will improve the predictive maintenance of industrial plants with two major use cases: connected windmills (GDF SUEZ, Woelfel) and customer satisfaction in car sale systems (MMC Rus). In both cases it is about non-personal, yet profitable big data. The Wendelin project actually demonstrates that Big data can improve infrastructure and everyday-life equipment without intrusive data collection. For more information, please see www.wendelin.io.

The project partners are:

- Nexedi (leader)
- GDF SUEZ
- Abilian
- 2ndQuadrant
- Institut Mines Télécom
- Inria
- Université Paris 13

PLEIADE Team (section vide)

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

POPIX has a contract with Lixoft (June 2011 - June 2015)

<p align="center" style="color:red">REO Project-Team</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. CIFRE convention

Participants: Céline Grandmont, Nicolas Pozin, Irène Vignon-Clementel.

CIFRE convention and contract with Air Liquide Santé International in the context of the ANRT on "Multiscale lung ventilation modeling in health and disease", for the PhD thesis of Nicolas Pozin (March 2014 - February 2017).

<p style="text-align:center">**SAGE Project-Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. ANDRA project

Participants: Yvan Crenner, Benjamin Delfino, Jean-Raynald de Dreuzy, Jocelyne Erhel.

Contract with ANDRA (National Agency for Nuclear Waste)
Duration: three years from November 2015.
Title: reactive transport in fractured porous media
Coordination: Jocelyne Erhel.
Partners: Geosciences Rennes.
Web page: http://www.irisa.fr/sage/
Abstract: Even in small numbers, fractures must be carefully considered for the geological disposal of radioactive wastes. They critically enhance diffusivity, speed up solute transport, extend mixing fronts and, in turn, modify the physicochemical conditions of reactivity around possible storage sites. Numerous studies in various fields have shown that fractures cannot be simply integrated within an equivalent po- rous medium with a simple enhancement of its petro-physical properties (porosity and permeability). We propose a combined numerical and experimental approach to determine the influence on reactivity of typical fracture patterns found in some radioactive waste applications.

SERENA Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

A one-year contract with the IFP Energies Nouvelles department of Applied mathematics on "Etudes d'estimations d'erreur a posteriori sur des maillages généraux" ("Study if a posteriori error estimates on general meshes) within the *contrat-cadre* between Inria and IFP Energies Nouvelles has been concluded and started.

8.2. Bilateral Grants with Industry

ANDRA is funding the Ph.D. thesis of S. Ali Hassan (an agreement that is part of an *accord cadre* between Inria and ANDRA).

SERPICO Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Contract with Innopsys: Tissue microarrays (TMA) image analysis*

Participants: Hoai Nam Nguyen, Charles Kervrann.

Collaborators: Vincent Paveau and Cyril Cauchois (Innopys).

A three-year contract has been established with Innopsis in 2013 to support Hoai Nam Nguyen's Ph-D thesis. The objective is to investigate and develop methods and algorithms dedicated to fluorescence images acquired by the scanners and devices designed by the company. In this project, we focus on i/ localization and segmentation fluorescence tissue microarrays (TMA) cores in very large 2D images; ii/ de-arraying of digital images and correction of grid deformation adapted to devices; iii/ correction of scanning artifacts to improve image reconstruction; iv/ deconvolution, denoising and superresolution of fluorescence TMA images corrupted by Poisson noise. The algorithms will be integrated into the plateforms and devices designed by Innopsis.

8.1.2. *Contract (CIFRE) with Technicolor: Semantically meaningful motion descriptors for video understanding*

Participants: Juan Manuel Perez Rua, Patrick Bouthemy.

Collaborators: Tomas Crivelli and Patrick Pérez (Technicolor).

A three-year contract has been established with Technicolor on January 2015 for a CIFRE grant supporting Juan Manuel Perez Rua's Ph-D thesis. The purpose is to investigate new methods for extracting meaningful mid-level motion-related descriptors that may help for the semantic discovery of the scene. In 2015, we started with the occlusion detection problem. We have proposed a novel approach where occlusion in the next frame or not is formulated in terms of visual reconstruction. Contrary to the ubiquitous displaced-frame-difference, the proposed alternative does not critically depend on a pre-computed, dense displacement field, while being shown to be more effective. We then leverage this local modeling within an energy-minimization framework that delivers occlusion maps. An easy-to-obtain collection of parametric motion models is exploited within the energy to provide the required level of motion information. Our approach outperforms state-of-the-art occlusion detection methods on the challenging MPI Sintel dataset.

8.2. Bilateral grants with industry

8.2.1. *Fourmentin-Guilbert Foundation: Macromolecule detection in cryo-electron tomograms*

Participants: Emmanuel Moebel, Charles Kervrann.

Collaborator: Damien Larivière (Fourmentin-Guilbert Foundation).

The Fourmentin-Guilbert Foundation strives for building a virtual E. coli bacteria. Information about the position of macromolecules within the cell is necessary to achieve such a 3D molecularly-detailed model. The Fourmentin-Guilbert Foundation supports cutting-edge *in-situ* cryo-electron tomography combined with image processing at the Max-Planck Institute of Biochemistry to map the spatial distribution of the ribosomes and obtain structural information on the complexes they form *in-situ* with cofactors and other ribosomes. The objective of the project is to explore and evaluate novel methods from the field of 3D shape retrieval for identifying, localizing and counting macromolecules (e.g. 70S ribosome) within a tomogram. This project is also supported by "Region Bretagne".

SISTM Project-Team (section vide)

STEEP Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

The PhD thesis of Jean-Yves Courtonne is co-sponsored by ARTELIA and Inria, via a bilateral contract.

Related to the former computer vision research activities of team members, we still had one contract with EADS Astrium Satellites (now Airbus Defence and Space), where we appear as sub-contractor: DECSA (DGA).

TONUS Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

We are involved in a common project with the company AxesSim in Strasbourg. The objective is to help to the development of a commercial software for the numerical simulation of electromagnetic phenomena. The applications are directed towards antenna design and electromagnetic compatibility. This project was partly supported by DGA through "RAPID" (régime d'appui à l'innovation duale) funds. The CIFRE PhD of Thomas Strub is part of this project. Another CIFRE PhD has started in AxesSim on the same kind of subjects in March 2015 (Bruno Weber). The new project is devoted to the use of runtime system in order to optimize DG solvers applied to electromagnetism. The resulting software will be applied to the numerical simulation of connected devices for clothes or medicine. The project is supported by the "Banque Public d'Investissemnt" (BPI) and coordinated by the Thales company.

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Guillaume Garin has been funded by ITK.

VISAGES Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *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 is a major advance in the collaboration since it will enable the development of MRI sequences on site.

8.2. Bilateral Grants with Industry

8.2.1. *MEDday*

As part of its activities, MEDday led the final testing phase on patients diagnosed from Multiple Sclerosis in order to find treatment of progressive multiple sclerosis. This is done in partnership with several hospitals in France. The goal is to achieve an effective treatment for this disease. The role of the team in this industrial grant is to develop new algorithms to perform the processing and the analysis of the images from this study.

ALPINES Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Contract with Total, February 2015 - February 2018, that funds the PhD of Hussam Al Daas on enlarged Krylov subspace methods for oil reservoir and seismic imaging applications. Supervisor, L. Grigori.

ASAP Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Technicolor

Participants: Fabien André, Anne-Marie Kermarrec.

We have a contract with Technicolor for collaboration on large-scale infrastructure for recommendation systems . In this context, Anne-Marie Kermarrec has been the PhD advisor of Fabien André since Nov 2013. Fabien André will work on efficient algorithms for heterogeneous data on large-scale platforms.

7.2. Web Alter-Egos Google Focused Award

Participants: George Giakkoupis, Anne-Marie Kermarrec, Nupur Mittal, Javier Olivares.

Duration: Sep. 2013 - Sep. 2015; Coordinator: Inria and EPFL.

This project addresses the problem of extracting the alter-egos of a Web user, namely profiles of like-minded users who share similar interests, across various Internet applications, in real time and in the presence of high dynamics. Beyond their intrinsic social interest, the profiles of alter-egos of a user are crucial to identify a personalized slice of the Internet that can be leveraged to personalize the Web navigation of that user. The expected outcome of the project is a generic architecture of a Web-Alter-Ego service that can run on various devices and use, as well as be used for, various Web applications.

<p style="text-align:center; color:red;">**ASCOLA Project-Team**</p>

7. Bilateral Contracts and Grants with Industry

7.1. Cooperation with SIGMA group

Participants: Thomas Ledoux [correspondent], Simon Dupont.

In 2012, we have started a 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 rapidly growing in number and size and have to urgently face with energy consumption issues. 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.

In 2015, we have presented an autonomic approach to manage cloud elasticity that obey cross-layer constraints [23].

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

Orange Labs (Cesson-Sévigné) is founding a PhD Thesis (CIFRE) on the topic of trust modeling on Web-RTC communications.

AVALON Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Animerique

One of the goals of the CapRézo company is to provide an original tool to make 2D/3D animation films. This tool is an innovative and distributed numerical platform. This platform is built on software developed by Avalon like DIET. Technologies developed in collaboration between CapRézo and Inria are based on Cloud federation environment. The collaboration, started in 2014, is scheduled for the next 5 years.

8.2. Bilateral Grants with Industry

8.2.1. NewGeneration-SR

We have a collaboration with the company NewGeneration-SR. The aim of this company is to reduce the energy impact through solutions on each layer of the energy consumption (from the data- center design and the production to usage). NewGeneration-SR improve the life cycle (design, production, recycling) in order to reduce the environmental impact of it. NewGeneration-SR was member of the Nu@ge consortium: one of five national Cloud Computing projects with "emprunts d'avenir" funding. With a CIFRE PhD student (Daniel Balouek), we are developing models to reduce the energy consumption for the benefit of data-center

8.2.2. IFPEN

We have collaboration with IFPEN. IFPEN develops numerical code to solve PDE with specific adaption of the preconditioning step to fit the requirement of their problems. With a PhD student (Adrien Roussel) we are studying parallel implementation of multi-level decomposition domain on many-core architecture and GPGPU.

<p style="text-align:center">**CIDRE Project-Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- **CS contract (2014-2016): "SecEF"**

  The SecEF contract consists in analyzing current used standards for information security events [39]. Such events following a standardized structure are needed to allow communications between the various security tools, in order to consolidate and correlate information, and for communications between different security response teams, to share information relative to incidents. Examples of such events are IDMEF (Intrusion Detection Message Exchange Format, RFC 4765) or IODEF (Incident Object Description Exchange Format, RFC 5070). Unfortunately, these two standards are insufficiently deployed on a market still dominated by proprietary formats. The objective of the SecEF (Security Exchange Format) project is thus to propose evolutions of these formats, based on the initial feedback from current users. During the first years of the project, we focused our work on alert formats. We conduced a comparative study of different alert formats and propose quantitative metrics to asses format expressiveness. We also proposed some evolutions for the IDMEF format and started the development of a generic library dedicated to IDMEF. This library could be used in different programming languages to generate and parse IDMEF messages. It will also support different encodings and transport protocols.

- **HP contract (2013-2016): "Embedded Systems Security"**

  We have initiated a research program in collaboration with HP Inc Labs in the domain of embedded systems security. We aim at researching and prototyping low-level intrusion detection mechanisms in embedded system software. This involves mechanisms in continuation of previous work realized by our team as well as investigating new techniques more directly tied to specific device architectures. In 2015, the project has been extended. We initiated a knew research work involving a Master student. The main objective of this extension is to monitor low-level software (firmware, OS kernels, hypervisors) thanks to a dedicated external co-processor. HP Inc Labs will fund a PhD on that subject. Details about this research program cannot be provided as they are covered by a non-disclosure agreement.

8.2. Bilateral Grants with Industry

- **DGA-MI: "BGP-like Inter Domain routing protocol for tactical mobile ad hoc networks: feasibility, performances and quality of service."**

  Florian Grandhomme is doing his PhD thesis in the context of a cooperation with DGA-MI. The goal of this thesis is to propose new secure and efficient algorithms and protocols to provide inter-domain routing in the context of tactical mobile ad hoc network. The protocol proposed will have to handle context modification due to the mobility of MANET, that is to say split of a MANET, merge of two or more MANET, and also handle hetereogeneity of technology and infrastructure. The solution will be independant from the underlying intra-domain routing protocol and from the infrastructure: wired or wireles, fixed or mobile.

- **DGA-MI: "Visualization for security events monitoring"**

  Damien Crémilleux was hired this year as a Ph.D. student on a DGA-MI funding to work on visualization for security events monitoring. The purpose of this thesis it to define relevant representations to allow front-line security operators to monitors systems from a security perspective. A first proposal was made that led to a tool, VEGAS, that allows to monitor large quantities of alerts in real time and to dispatch these alerts in a relevant way to security analysts. VEGAS was presented during the poster session in VizSec 2015 [58] that took place in Chicago, Illinois on the 26th of October 2015.

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

  Pierre Obame is doing his PhD thesis in the context of a CIFRE contract with Orange Labs at Rennes. Pierre Obame has proposed a distributed storage system called Mistore, dedicated to users who access Internet via a Digital Subscriber Line (DSL) technology. This system aims at guaranteeing data availability, persistence, and low access latency by leveraging millions of home gateways and the hundreds of Points of Presence (POP) of an Internet Service Provider (ISP) infrastructure. Pierre Obame has also proposed a mathematical framework for defining both strong and weak consistency criteria within the same formalism. These criteria are offered by Mistore to its clients when they manipulate their data. Pierre Obame, whose PhD thesis is planned to terminate in 2016, is in the process of writing his PhD manuscript so as to defend it in 2016.

- **Orange Labs: "Privacy-preserving location-based services"**

  Solenn Brunet has started her PhD thesis since 2014 within the context of a CIFRE contract with Orange Labs Caen. Her PhD subject concerns the development of privacy-preserving location-based services that are able to personalize the service provided to the user according to his current position while preserving his location privacy. In particular, Solenn will adapt existing cryptographic primitives (private information retrieval, secure multiparty computation, secure set intersection, ...) or design novel ones to use them as building blocks for the construction of these privacy-preserving location-based services. A first paper on the development of a privacy-preserving e-toll service based on the partially blind signature has just been accepted for publication.

- **DGA-MI: "Security events visualization"**

  Christopher Humphries defended his Ph.D. thesis on the 8th of December 2015. This Ph.D. was funded by DGA-MI. The objective of this thesis was to propose new visualization mechanisms dedicated to the analysis of security events, for instance for forensic purposes. Two tools, ELVIS and CORGI, were produced. This research led to two publications in VizSec, which is the most famous venue on the topic of visualization for security.

- **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 started in November 2012 and is expected to finish in 2016. The current work consists in the automatic generation of alert correlation rules in the context of deployed distributed systems. The correlation rules aim at being used by our GnG correlation system.

<p style="text-align:center;color:red;font-weight:bold;">COAST Project-Team</p>

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Grants with Industry

6.1.1. CIFRE Grant with Bonitasoft

Participants: François Charoy, Samir Youcef, Guillaume Rosinosky.

Bonitasoft is a leading software company in the domain of open source Business Process Management Systems. The objective of this grant is to help Bonitasoft to support effective elastic BPM operation in the Cloud by leveraging both the business knowledge, the process models and the execution history of process instances and correlate them with cloud resource consumption. Guillaume Rosinosky has been recruited as a PhD Student to work on this project. We will define models that will be validated based on a detailed analysis of existing use cases that we have started to collect from Bonitasoft and its clients.

<p align="center" style="color:red">COATI Project-Team</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Amadeus

Participants: Marco Biazzini, David Coudert, Stéphane Pérennes, Michel Syska.

Duration: May 2014 - April 2015

Inria teams: COATI, SCALE

Abstract: This collaboration aims at assessing the benefits that digital technologies can bring in complex travel distribution applications. Indeed, these applications require both high performance algorithms and distributed programming methods to search for the best solutions among billions of combinations, in a very short time thanks to the simultaneous use of several hundreds (if not thousands) of computers. These benefits will be demonstrated in an application to build 'off the shelf' optimized packages, fully customized to best meet the complex demands of the traveler.

8.2. Bilateral Grants with Industry

8.2.1. Contract CIFRE with KONTRON

Participants: Michel Syska, Mohamed Amine Bergach.

We have contracted with KONTRON (worldwide company which designs and manufactures embedded systems) a "Convention de recherche encadrant une bourse CIFRE" on the topic *Graphic Processing Units for Signal Processing*, which work is a joint supervision with AOSTE project.

Duration: November 2011 - April 2015

8.2.2. ADR Network Science, joint laboratory Inria / Alcatel-Lucent Bell-labs France

Participants: David Coudert, Nicolas Nisse.

COATI is part of the joint laboratory Inria / Alcatel-Lucent Bell-labs France within the ADR Network Science and works on the fast computation of topological properties (hyperbolicity, covering, etc.).

Duration: January 2013 - December 2015

8.2.3. Allocation Carnot Inria / Instant System

Participants: David Coudert, Idriss Hassine.

The Instant System startup company develop a platform in the area of Intelligent transportation systems (ITS). The partnership with COATI aims at designing algorithms for itinerary planning in multimodal transportation networks. The main objective is to combine public transport system and dynamic car-pooling.

Duration: December 2015 - November 2016 (12 man-month)

CTRL-A Team

8. Bilateral Contracts and Grants with Industry

8.1. CIFRE PhD grant Orange

This Cifre PhD started in the beginning of 2012, and was defended in may 2015, on the topic of "Discrete Control in the Internet of things and Smart Environments through a Shared Infrastructure" [8]. Hassane Alla and Eric Rutten advised the PhD student for 10%.

One result of this cooperation is that a patent deposited at the INPI on "Configuration automatique du controle discret d'entites physiques dans un systeme de supervision et de controle", by Gilles Privat et Mengxuan Zhao (Orange labs), Hassane Alla (Gipsa-lab), Eric Rutten (Inria).

8.2. Bilateral Grants with Industry

Our cooperation with CEA LETI/LIST DACLE at Grenoble Minatec is bilateral, involving the CEA PhD grant of Adja Sylla, to work with F. Pacull and M. Louvel on high-level programming on top of a rule-based middleware.

<p style="text-align:center; color:red">DANTE Project-Team</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. HiKoB
Participant: Éric Fleury.

A bilateral contract has been signed between the DANTE Inria team and HiKoB to formalise 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.

8.1.2. GranDATA
Participants: Márton Karsai [correspondant], Éric Fleury.

Founded in 2012, Grandata is a Palo Alto-based company that leverages advanced research in Human Dynamics (the application of "big data" to social relationships and human behavior) to identify market trends and predict customer actions. Leading telecom and financial services firms are using Grandata's Social Universe product to transform "big data" into impressive business results.

The DANTE team and Grandata started to collaborate in 2014 on the analysis of large datasets provided by the company. The aim of the collaboration is to gain better understanding about the dynamical patterns of human interactions, mobility, and the socio-economic structure of the society. As a part of this collaboration Carlos Sarraute (Grandata - R&D Director) visited the Dante team on November and Yannick Leo (DANTE - PhD student) visited Grandata office in Buenos Aires in 2014 December.

8.1.3. STACC, Skype/Microsoft Labs
Participant: Márton Karsai [correspondant].

The Software Technology and Applications Competence Centre (STACC) is a research and development centre conducting high-priority applied research in the field of data mining and software and services engineering. Together with Skype/Microsoft Labs, STACC maintains a long lasting research collaboration with Márton Karsai (DANTE) on the modeling the adoption dynamics of online services.

8.2. Inria Alcatel-Lucent Bell Labs joint laboratory
Participants: Isabelle Guérin Lassous, Paulo Gonçalves Andrade, Thomas Begin, Éric Fleury [correspondant].

The main scientific objectives of the collaboration within the framework Inria Alcatel-Lucent Bell Labs joint laboratory is focused on network science:

- to design efficient tools for measuring specific properties of large scale complex networks and their dynamics;
- to propose accurate graph and dynamics models (*e.g.*, generators of random graph fulfilling measured properties);
- to use this knowledge with an algorithmic perspectives, for instance, for improving the QoS of routing schemes, the speed of information spreading, the selection of a target audience for advertisements, etc.

8.3. Bilateral Grants with Industry

8.3.1. Orange R&D

Participant: Isabelle Guérin Lassous.

A contract has been signed between Inria and France Télécom for the PhD supervision of Laurent Reynaud. The PhD thesis subject concerns mobility strategies for fault resilience and energy conservation in wireless networks.

<p style="text-align:center; color:red;">**DIANA Project-Team**</p>

7. Bilateral Contracts and Grants with Industry

7.1. Programmable data plane network functions

In the context of the common Inria - Alcatel Lucent Bell-Labs laboratory on Communication networks of the future, we participate to the Content Centric Networking ADR (Action de Recherche). In the context of this ADR, a post-doctoral position is working on the Most network applications and network functions today are implemented using specialized hardware middleboxes. The dedicated specialized hardware makes packet processing rates match that of the line rates that has been difficult to achieve on general purpose hardware. Recently the advancement in general purpose processors has made it possible to use general purpose CPU's for packet processing at line rates. If general purpose CPU's can replace dedicated hardware, this will drastically reduces the cost as the network functions can be moved from dedicated hardware to software. Currently, Virtualization has been promoted to realize network functions on general purpose computing devices and this currently popular in both academia and industry. There are a number of problems with using virtualization to realize network functions, the most important being the latency introduced by the software stacks. In this work, we will be looking at alternative approaches to implementing network functions on general purpose hardware. One of the main outcomes will be an approach that performs much better than the existing solutions. One of the goals of the work will be to find appropriate use cases for which the proposed architecture is a clear advantage with respect to other NFV solutions. Alcatel Lucent has joined Nokia in 2015. See http://company. nokia.com/en.

7.2. Privacy leaks monitoring and control

We are collaborating with the startup Novathings to deploy early stage privacy leaks monitoring and control solutions. We have proposed in Meddle a VPN based infrastructure performing SSL-bumping in order to capture all the mobile data traffic and to inspect even the SSL flows. The biggest advantage is that, as most mobile platforms support VPNs, we don't need any installation or root access on the devices to perform traffic redirection and inspection. We have a Carnot funding for a one year engineer position that started in April 2015 to implement a new solution on a home appliance sold by Novathings to improve transparency and control for personal devices.

We implemented a first prototype on a raspberry Pi device and started an integration following the Novathings graphical chart. See http://www.novathings.com/#/?lang=en.

DIONYSOS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contract with Industry: ALSTOM-Inria Common Lab

Participants: Bruno Tuffin, Gerardo Rubino.

Bruno Tuffin is the co-director of ALSTOM-Inria common Lab.

The group currently manages a project with ALSTOM on system availability simulation taking into account logistic constraints. Current ALSTOM Transport and Power contracts, especially service-level agreements, impose stringent system availability objectives. Non-adherence to the required performance levels often leads to penalties, and it is therefore critical to assess corresponding risk already at a tender stage. The challenge is to achieve accurate results in a reasonable amount of time. Monte Carlo simulation provides estimates of the quantities it is desired to predict (e.g., availability). Since we deal with rare events, variance reduction techniques, specifically Importance Sampling (IS) here, is used. The goal of the project is to establish the feasibility of IS for solving problems relevant to ALSTOM and to develop the corresponding mathematical tools.

7.2. Bilateral Contract with Industry: Participation in a CRE with Orange

Participant: Bruno Tuffin.

We are participating to a CRE (managed by Telecom Bretagne) with Orange on the strategies of Content Delivery Networks (CDNs) and their impact on the overall Internet economy and regulation. In this study, we focus on the CDN as an economic actor. The goals are 1) to analyze CDNs' caching strategies from an economic point of view, 2) to study the strategies of an integrated CDN actor, and 3) to study the impact of CDNs in the net neutrality debate.

7.3. Cifre contract on Device-Assisted Distributed Machine-Learning on Many Cores

Participants: Corentin Hardy, Bruno Sericola.

This is a Cifre contract including a PhD thesis supervision, done with Technicolor. The starting point of this thesis would be to consider the possibility to deploy machine-learning algorithms over many cores, but out of the datacenter: on the devices (home-gateways) deployed by Technicolor in users' homes. In this device-assisted view, an initial processing step in the device may significantly reduce the burden on the datacenter back-end. Problems are numerous (power consumption, CPU power, network bandwidth and latency), but costs for the operator can be lowered and scale may bring some new level in data processing.

7.4. Cifre contract on Small Cell Networks

Participants: Adlen Ksentini, César Viho.

This is a Cifre contract (2013-2016) including PhD thesis supervision, done with Orange Labs, on cooperation and self-* small cell networks. The aim is to define architectures and protocols for deploying small cell networks in AMEA (Africa, Middle East and Asia) countries.

7.5. Cifre contract on SDN for 5G mobile networks

Participant: Adlen Ksentini.

This is a Cifre contract (2015-2018) including PhD thesis supervision, done with TDF, on cooperation the use SDN for the 5 generation of mobile network. The objective of the thesis is to study and devise appropriate solutions to introduce SDN with the current LTE architecture toward 5G.

7.6. DGA Grant

Participant: Adlen Ksentini.

This DGA grant, with Cidre Inria team, is for the PhD supervision of Florient Grandhomme.

7.7. DVD2C

Participants: Adlen Ksentini, Pantelis Frangoudis.

We are working in the 3-year (September 2014 – September 2017) FUI Project DVD2C, which aims to virtualize CDN through the Cloud and Network Function Virtualization concept. DVD2C is leaded by Orange labs., and the partners are two SMEs (Viotech and Resonate) and two academics (our team and Télécom Paris Sud).

7.8. Cifre contract on a dynamic adaptive service-driven SDN architecture

Participants: Jean-Michel Sanner, Yassine Hadjadj-Aoul, Gerardo Rubino.

This is a Cifre contract (2013-2016) including the supervision and work of the PhD thesis of Jean-Michel Sanner, done with Orange Labs, on defining a dynamic adaptive service-driven network architectures based on the SDN concept.

7.9. Cifre contract on defining an open, a flexible and a unified network architecture

Participants: Yue Li, Yassine Hadjadj-Aoul, Gerardo Rubino.

This is a Cifre contract (2013-2016) including the supervision and work of the PhD thesis of, done with Orange Labs, on designing an open, flexible and unified network architecture.

7.10. Camion

Participants: Yassine Hadjadj-Aoul, César Viho, Raymond Marie, Thiago Wanderley Matos de Abreu.

We are working in the 2-year (October 2014 to October 2016) Eurostars European Project Camion, which aims at offering cost-efficient, QoE-optimized content delivery, allowing for faster content access, as well as offline operation, while improving wireless network capacity and coverage. Camion is leaded by JCP-Connect, and the partners are a SME (FON) and our team.

DIVERSE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. April

This work is performed in collaboration with APRIL Technologies. This company develops all the IT solutions for APRIL group [0] and their clients in the insurance business. They have a very large information system that they specialize for all the divisions of the group. A critical need for them is to ensure that changes in their applications (new features, bug repair, etc.) do not degrade functional correctness and performance.

Software testing techniques and tools have greatly improved over the last decade and it is now possible for software developers to write test cases that are automatically executed. Consequently, each time the program evolves, it is rebuild and re-tested automatically, which supports the detection of errors early in the process and prevents the propagation of the bug into the production code. However, the test cases are manually written and are thus usually weak when it comes at finding bugs that are deep in the code or in nested loops for example. The main challenge of this work is automatically generate new test cases that increase the effectiveness of regression testing.

In this project we aim at automatically generating new test cases from the ones that have been manually produced by the developers, in order to add value in the continuous integration process and improve the quality of software that goes in production. The process of automatically producing new test cases from existing ones is called *test amplification*. We can experiment our recent results about test transformations on APRIL Technologies's set of test cases very early in the project.

This project supports one postdoc in the DiverSE team and is funded by Inria's transfer and industrial partnership department.

8.2. Bilateral Grants with Industry

8.2.1. Partnership with Thales

Dates: 2011-2014

This partnership with Thales Research and Technology explores variability management both in modeling and metamodeling (*i.e.*, design and implementation of software languages). At the model level, this collaboration is a direct follow-up of the MOVIDA and the MUTATION projects, in which we explore the challenges related to software product line and multi-view engineering for the different development phases of systems of systems construction. At the metamodeling level, we investigate how the notions of variability modeling and management can serve the rigorous definition of families of modeling languages, which address the different interpretations of UML needed to model the different viewpoints in the systems engineering.

The project 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.

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[0] http://groupe.april.fr/groupe

<p align="center">**DYOGENE Project-Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. CRE with Orange

One year CRE contract titled "Détermination de la distribution des conditions radio validée avec les données terrain pour les outils de dimensionnement" (Determining the distribution of the radio channel conditions validated by the real data for network dimensioning tools) between Inria and Orange Labs have been signed in 2015. It is a part of the long-term collaboration between TREC/DYOGENE and Orange Labs, represented by M. K. Karray, for the development of analytic tools for the QoS evaluation and dimensioning of operator cellular networks. Arpan Chattopadhyay was hired by Inria as a post-doctoral fellow thanks to this contract.

8.2. MSR-Inria Joint Lab

- Social Information Networks and Privacy
  Online Social networks provide a new way of accessing and collectively treating information. Their efficiency is critically predicated on the quality of information provided, the ability of users to assess such quality, and to connect to like-minded users to exchange useful content.

  To improve this efficiency, we develop mechanisms for assessing users' expertise and recommending suitable content. We further develop algorithms for identifying latent user communities and recommending potential contacts to users.

- Machine Learning and Big Data
  Multi-Armed Bandit (MAB) problems constitute a generic benchmark model for learning to make sequential decisions under uncertainty. They capture the trade-off between exploring decisions to learn the statistical properties of the corresponding rewards, and exploiting decisions that have generated the highest rewards so far. In this project, we aim at investigating bandit problems with a large set of available decisions, with structured rewards. The project addresses bandit problems with known and unknown structure, and targets specific applications in online advertising, recommendation and ranking systems.

EVA Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. CNES

Participants: Ines Khoufi, Pascale Minet, Erwan Livolant.

Partners: CNES, Inria.
Following the SAHARA project that ended in 2015, CNES decided to fund a study about the use of wireless sensor networks in space environment. This new project started in November 2015 and will end in November 2016.

8.2. Bilateral Grants with Industry

8.2.1. Gridbee CIFRE

Participants: Thomas Watteyne, Jonathan Muñoz.

- Title: km-scale Industrial Networking
- Type: CIFRE agreement
- Period: Nov 2015 - Oct 2018
- Coordinator: **Thomas Watteyne**
- Goal: CIFRE agreement with Gridbee (http://www.gridbeecom.com/) to apply 6TiSCH-style scheduling on top of long-range IEEE802.15.4g radios. Implementation of those solutions on OpenWSN.

8.2.2. SAGEM

Participants: Paul Muhlethaler, Gerard Le Lann.

This work aims at improving the reliability of some SAGEM communications systems. A few "altruist" algorithms using the inherent broadcast capabilities of wireless transmission have been analyzed.

FOCUS Project-Team (section vide)

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Traxens partnershipTraxens partnership
  Participants: Natale Guzzo, Nathalie Mitton [correspondant].

  This collaboration aims to set up a full protocol stack for TRAXENS's guideline. This collaboration is a CIFRE contract. In the framework of this collaboration, a full protocol stack has been developed for the purpose of container monitoring. 3 national and 2 international patents have been submitted so far. 2 are under preparation.

<p style="text-align:center;color:red;">**GANG Project-Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. Collaboration with Bell Labs

Gang has a strong collaboration with Bell Labs (Alcatel-Lucent / Nokia). We notably collaborate with Fabien Mathieu and Diego Perino who are former members of GANG that have joined Alcatel-Lucent. A Cifre grant allowed to fund the PhD thesis of The-Dang Huynh to study ranking techniques and their application to social networks. An ADR (joint research action) is dedicated to content centric networks and forwarding information verification. The PhD thesis of Leonardo Linguaglossa is funded by this contract. We also collaborate with Ludovic Noirie on voting systems.

This collaboration is developed inside the Alcatel-Lucent and Inria joint research lab.

HIEPACS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Airbus Defence and Space research and development contract:

- Design of a parallel version of the FLUSEPA software (Jean-Marie Couteyen (PhD); Pierre Brenner, Jean Roman).

CEA DPTA research and development contract:

- The objective was to evaluate if our ScalFMM library could be used to compute electrostatic interactions in molecular dynamics code (Stamp) of the CEA.

CEA-CESTA research and development contract:

- Performance analysis of the recent improvements in PaStiX sparse direct solver for matrices coming from different applications developped at CEA-CESTA.

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 (Moustafa Salli (PhD); Mathieu Faverge, Pierre Ramet, Jean Roman).

TOTAL research and development contracts:

- Parallel hybrid solver for massivelly heterogeneoux manycore platforms (Stojce Nakov (PhD); Emmanuel Agullo, Luc Giraud, Abdou Guermouche, Jean Roman).

8.2. Bilateral Grants with Industry

Airbus Group Innovations research and development contract:

- Design and implementation of temporal FMM calculation (B. Bramas (PhD); Olivier Coulaud, Guillaume Sylvand).

- Design and implementation of FMM and block Krylov solver for BEM applications. The HIBOX project is led by the SME IMACS and funded by the DGA Rapid programme (C. Piacibello (Engineer), Olivier Coulaud, Luc Giraud).

INDES Project-Team (section vide)

<div align="center" style="color:red">**INFINE Team**</div>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

1. Participation to Microsoft Research – Inria Joint Centre, which funds two PhD students (Lennart Gulikers and Remi Varloot) and funded postdoc Kuang Xu over 2015.
2. During 2015, Cisco Systems (through direct contract) and Google (through GSoC) have funded further development of RIOT.

7.2. GranData

Participants: Aline Carneiro Viana, Eduardo Mucelli.

Since June 2014, we have a collaboration with GranData (http://grandata.com/), Buenos Aires, Argentina on traffic vs mobility modeling of smartphone users. GranData is a small company that integrates first-party and telco partner data to understand key market trends, to predict customer behavior, and to deliver business results. Its products integrates and analyzes diverse data traces (e.g., telco, social media, or mobile data) to generate behavioral insights and deliver targeted mobile marketing. Part of the thesis of Eduardo Mucelli analysis data traffic using telco traces provided by GranDatas. While this collaboration allow us collaborating with machine learning experts, GranData has the opportunity to get our expertise in mobility analysis.

KERDATA Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Microsoft: Z-CloudFlow (2013–2016).   In the framework of the Joint Inria-Microsoft Research Center, this project is a follow-up to the A-Brain project. The goal of this new project is to propose a framework for the efficient processing of scientific workflows in clouds. This approach will leverage the cloud infrastructure capabilities for handling and processing large data volumes. In order to support data-intensive workflows, the cloud-based solution will: adapt the workflows to the cloud environment and exploit its capabilities; optimize data transfers to provide reasonable times; manage data and tasks so that they can be efficiently placed and accessed during execution. The validation will be performed using real-life applications, first on the Grid5000 platform, then on the Azure cloud environment, access being granted by Microsoft through a *Azure for Research Award* received by G. Antoniu. The project also provides funding for the PhD thesis of Luis Pineda, started in 2014. The project is being conducted in collaboration with the Zenith team from Montpellier, led by Patrick Valduriez.

<p align="center">**MADYNES Project-Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Xilopix (Epinal, France):
    - Pay-per-use contract for the use of Grid'5000
    - Support contract for their use of Grid'5000 (define experimental requirements and plans)

8.2. Bilateral Grants with Industry

- CIFRE, Thales TRT (Paris, France):
    - CIFRE PhD (Florian Greff, managed by Ye-Qiong Song and Laurent Ciarletta)
    - Dynamic reconfiguration and graceful degradation of distributed real-time applications over mesh networks
- CIFRE, Orange Labs (Issy-Les-Moulineaux, France)
    - CIFRE PhD (Maxime Compastie, managed by Olivier Festor and Remi Badonnel)
    - Software-Defined Security for Distributed Cloud Infrastructures
- CIFRE, Xilopix (Epinal, France):
    - CIFRE PhD (Abdulqawi Saif, managed by Ye-Qiong Song and Lucas Nussbaum)
    - Open Science for the scalability of a new generation search technology

<p align="center" style="color:red">MAESTRO Project-Team</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

MAESTRO members are involved in the

- Inria Alcatel-Lucent Bell Labs joint laboratory: the joint laboratory consists of six ADRs (Action de Recherche/Research Action) in its second phase (starting October 2012). MAESTRO members participate in two ADRs (see §8.1.1 and §8.1.2).

- Inria ALSTOM joint laboratory: the joint laboratory consists of four projects. MAESTRO members participate in project P11 (see §8.1.3).

8.1.1. ADR "Self-Organized Networks in Wireless" (July 2008 – June 2016)
Participant: Eitan Altman.

- Contractor: Alcatel-Lucent Bell Labs (http://www.alcatel-lucent.com/bell-labs)
- Collaborators: Laurent Roullet (coordinator), Véronique Capdevielle.

Coordinator for Inria: Bruno Gaujal (team MESCAL).

During the investigations carried out within this ADR, in collaboration with Alcatel-Lucent Bell Labs and WIRELESS ENB teams (System Engineering and Modem), three technical solutions to the LTE Mobility State Estimation problem have been proposed. In particular,

- Three patents have been submitted and filed (two in 2013, and one in 2014);
- A white paper written by the joint team (Inria/Bell-Labs and Wireless SE) summarizing the theoretical baseline of the methods, their performances, as well as the implementation issues, is documented.

These solutions have been set up between Inria and Alcatel-Lucent Bell Labs iteratively after numerous meetings, in order to cope with the product requirements.

8.1.2. ADR "Network Science" (June 2013 – August 2016)
Participants: Konstantin Avrachenkov [coordinator], Jithin Kazhuthuveettil Sreedharan, Philippe Nain, Giovanni Neglia.

- Contractor: Alcatel-Lucent Bell Labs (http://www.alcatel-lucent.com/bell-labs)
- Collaborators: Philippe Jacquet (coordinator), Alonso Silva.

"Network Science" aims at understanding the structural properties and the dynamics of various kind of large scale, possibly dynamic, networks in telecommunication (e.g., the Internet, the web graph, peer-to-peer networks), social science (e.g., community of interest, advertisement, recommendation systems), bibliometrics (e.g., citations, co-authors), biology (e.g., spread of an epidemic, protein-protein interactions), and physics. The complex networks encountered in these areas share common properties such as power law degree distribution, small average distances, community structure, etc. Many general questions/applications (e.g., community detection, epidemic spreading, search, anomaly detection) are common in various disciplines and are being analyzed in this ADR "Network Science". In particular, in the framework of this ADR we are interested in efficient network sampling (see §7.1.2).

8.1.3. Project P11 "Data Communication Network Performance" (December 2013 – May 2016)

Participants: Sara Alouf [coordinator], Konstantin Avrachenkov, Abdulhalim Dandoush, Philippe Nain, Giovanni Neglia, Alina Tuholukova.

- Contractor: ALSTOM Transport (http://www.alstom.com/transport/)
- Collaborators: Pierre Cotelle, Pascal Derouet (coordinator from November 2015), Pierre Dersin, Sébastien Simoens (coordinator until October 2015).

The objective of this study is to build a simulation platform (see §6.2) and develop an evaluation methodology for predicting Quality of Service and availability of the various applications supported by the data communication system of train networks.

8.2. Bilateral Grants with Industry

8.2.1. "Multi-Objective Optimization for LTE-Advanced Networks" (December 2012 – November 2015)

Participant: Eitan Altman.

- Contractor: Orange Labs (http://www.orange.com/en/innovation)
- Collaborators: Zwi Altman, Abdoulaye Tall.

The objective of this Cifre thesis is threefold: (1) to develop solutions based on stochastic approximations and optimal control for the optimization and setting of LTE-Advanced Networks; (2) to develop queuing models to capture the dynamics of the traffic and the physical layer mechanisms (e.g. relay, MIMO, scheduling); and (3) to apply the developed methods to engineering problems such the interference management, load balancing, optimization of coverage and capacity, and mobility management.

<p align="center">**MESCAL Project-Team**</p>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry: Alcatel Lucent-Bell

A common laboratory between Inria and the Alcatel Lucent-Bell Labs was created in early 2008 and consists on three research groups (ADR). MESCAL leads the ADR on self-optimizing networks (SELFNET). The researchers involved in this project are Bruno Gaujal and Panayotis Mertikopoulos.

7.2. Bilateral Contracts with Industry: Stimergy

Stimergy is a startup that aims at developing a distributed data center built by connecting mini data centers embedded in digital boilers installed in multi-unit residential buildings. Each boiler contains several servers and the dissipated power can thus be used to cover a large part of the annual energy requirements for preparing domestic hot water for a building. Such infrastructure drastically reduces the energy required to operate data centers, while reducing total cost of infrastructure and ownership. Mescal (Olivier Richard, and Michael Mercier, full-time Inria engineer) provides the necessary expertise for the realization and implementation of software infrastructure allowing the coordination of operating such mini data center.

MIMOVE Team (section vide)

<p style="color:red; text-align:center;">**MOAIS Project-Team**</p>

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

6.1.1. CEA

Thanks to past collaboration with CEA, XKaapi was used for multi-core version of EPX. We have a contract with CEA [2014-2015] to manage transition from XKaapi to OpenMP as well as specific loop scheduling among hierarchical NUMA architecture.

<p style="text-align:center">**MUSE Team**</p>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- "Improving the quality of recommendation using semi-structured user feedback" CIFRE contract with Technicolor for thesis of Sara el Aouad from May 2014 to April 2017.

- "Crowdsourced Home Network Diagnosis" CIFRE contract with Technicolor for thesis of Diego da Hora from February 2014 to January 2017.

- "Exploiting Network Content-awareness to provide novel added value services" contract under the Inria-Alcatel Lucent Bell Labs common Lab (ADR ICN) to fund the doctoral thesis of Giuseppe Scavo from November 2013 to October 2016.

7.2. Bilateral Grants with Industry

- "Collaborative Home Network Troubleshooting", Comcast grant, from December 2015.

MYRIADS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Thales Research and Technology*

Participants: Baptiste Goupille–lescar, Christine Morin, Nikolaos Parlavantzas.

Our collaboration with Thales Research and Technology focuses on the development of distributed Cyber-Physical Systems, such as those developed by Thales to monitor and react to changing physical environments. These systems need to be highly adaptable in order to cope with the dynamism and diversity of their operating environments. Notably, they require distributed, parallel architectures that support dynamic sets of applications, not known in advance, while providing strong QoS guarantees. The objective of this collaboration is to explore adaptive resource management mechanisms for such systems that can adapt to changes in the requirements and in the availability of resources. From November 2015 to December 2015, we performed a state of the art study on resource management in virtualized computing infrastructures to cope with cyber-physical system constraints.

PHOENIX Project-Team (section vide)

<p style="text-align:center; color:red">RAP Project-Team</p>

5. Bilateral Contracts and Grants with Industry

5.1. Bilateral Contracts with Industry

- Contrat de recherche externalisé avec ORANGE SA "Scheduling Global OS". Duration three years 2014-2016.
- *Christine Fricker* is the leader of PGMO project "Systèmes de véhicules en libre-service: Modélisation, Analyse et Optimisation" with G-Scop (CNRS lab, Grenoble) and Ifsttar. From 1 to 3 years. From 1/10/2013 to 30/9/2016.
- PhD grant CJS (Contrat Jeune Scientifique) Frontières du vivant of INRA for Renaud Dessalles.
- PhD grant from Fondation Sciences Mathématiques de Paris for Wen Sun.
- PhD grant from Brazilian Government for Guilherme Thompson.

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. Joint industrial PhD with Orange Labs and Renault

- Orange Lab, 30,000 euros for 1 PhD Students (CIFRE), Ralucca Diaconu
- Renault, 60,000 over 3 years (2013 - 2016) for a CIFRE. In the context of a Cifre cooperation with Renault, we are supervising with Whipser the PhD of Antoine Blin on the topic of scheduling processes on a multicore machine for the automotive industry. The goal is to allow real-time and multimedia applications to cohabit on a single processor. The challenge here is to control resource consumption of non real-time processes so as to preserve the real-time behavior of critical ones. As part of this cooperation, we will use the Bossa DSL framework for implementing process schedulers that we have previously developed.

7.1.2. Joint industrial PhD: CRDTs for Large-Scale Storage Systems, with Scality SA

This year, we continued the joint CIFRE (industrial PhD) research of Tao Thanh Vinh, with the French start-up company Scality, as described above (under "Large-Scale File Systems").

The objective of this research is to design new algorithms for file and block storage systems, considering both the issues of scaling the file naming tree to a very large size, and the issue of conflicting updates to files or to the name tree, in the case of high latency or disconnected work. Preliminary results were published at Systor 2015 [58].

7.1.3. EMR CREDIT, with Thales.

Franck Petit and Swan Dubois participate to the creation of the EMR (Equipe Mixte de Recherche) *CREDIT*, (Compréhension, Représentation et Exploitation Des Interactions Temporelles) between LIP6/UPMC and Thales.

Nowadays, networks are the field of temporal interactions that occur in many settings networks, including security issues. The amount and the speed of such interactions increases everyday. Until recently, the dynamics of these objects was little studied due to the lack of appropriate tools and methods. However, it becomes crucial to understand the dynamics of these interactions. Typically, how can we detect failures or attacks in network traffic, fraud in financial transactions, bugs or attacks traces of software execution. More generally, we seek to identify patterns in the dynamics of interactions. Recently, several different approaches have been proposed to study such interactions. For instance, by merging all interactions taking place over a period (e.g. one day) in a graph that are studied thereafter (evolving graphs). Another approach was to built meta-objects by duplicating entities at each unit of time of their activity, and by connecting them together.

The goal of the EMR is to join both teams of LIP6 and Thales on these issues. More specifically, we hope to make significant progress on security issues such as anomaly detection. This requires the use of a formalism sufficiently expressive to formulate complex temporal properties. Recently, a vast collection of concepts, formalisms, and models has been unified in a framework called Time-Varying Graphs. We want to pursuit that way. In the short run, the challenges facing us are: (1) refine the model to capture some interaction patterns, (2) design of algorithms to separate sequences of interactions, (3) Identify classes of entities playing a particular role in the dynamics, such as bridges between communities, or sources and sinks.

7.1.4. Joint industrial PhDs: data sharing in mobile networks and automatic resizing of shared I/O caches, with Magency

Magency organizes large events during which participants can use mobile devices to access related data and interact together.

The thesis of Lyes Hamidouche concerns efficient data sharing among a large number of mobile devices. Magency brings traces captured during real events (data accesses and user mobility). We are jointly working on the design of algorithms allowing a large number of mobile devices to efficiently access remote data.

Magency also runs servers. A server is used before an event in order to be prepared and tested, and then, during the event to serve the numerous mobile devices accesses. Many servers are run on a single physical machine using containers. Using this configuration, the memory is partitioned, leading to poor performances for applications that need a large amount of memory for caching purpose. In the context of Damien Carver's PhD thesis, we are designing kernel-level mechanisms that automatically give more memory to the most active containers, leveraging the expertise acquired during Maxime Lorrillere's PhD thesis.

<p style="text-align:center; color:red; font-weight:bold;">RMOD Project-Team</p>

8. Bilateral Contracts and Grants with Industry

8.1. SafePython FUI

Participants: Damien Cassou [Correspondant], Jean-Baptiste Arnaud, Stéphane Ducasse.

Contracting parties: CEA, Evitech, Inria, Logilab, Opida, Thales, Wallix.

Beyond embedded computing, there is not so much research and development on the verification of software safety. Recently, some tools have been created for languages such as JAVA, SQL, VB or PHP. Nevertheless, nothing exists for Python even though this language is growing fast. SafePython's goal is to provide code analysis tools applicable to Python programs. This project will define a subset of Python that the developers will have to use to have their programs analyzed.

8.2. Sponsoring LAM

Participants: Stéphane Ducasse [Correspondant], Marcus Denker.

Contracting parties: Inria, LAM Research, Inc.

LAM Research Inc.(http://lamrc.com) is a leading supplier of wafer fabrication equipment and services to the global semiconductor industry. LAM has started to sponsor RMOD in 2014. RMOD used the sponsored funds to pay student internships in 2015.

8.3. Worldline CIFRE

Participants: Anne Etien [Correspondant], Nicolas Anquetil, Stéphane Ducasse, Vincent Blondeau.

In the context of a CIFRE PhD we are working on large industrial project characterization. The PhD started in October 2014.

8.4. Pharo Consortium

The Pharo Consortium was founded in 2012 and is growing constantly. As of end 2015, it has 19 company members, 13 academic partners and 3 sponsoring companies. Inria supports the consortium with one full time engineer starting in 2011. More at http://consortium.pharo.org.

<h1 style="text-align:center; color:red">ROMA Project-Team</h1>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Mumps Consortium (2014-2019)

In the context of the MUMPS consortium (http://mumps-consortium.org):

- We have signed three new membership agreements, with ESI-Group, Siemens SISW (Belgium) and TOTAL in 2015, on top of the on-going agreements signed in 2014 with Altair, EDF, LSTC, Michelin.
- We have organized point-to-point meetings with several members.
- We have provided technical support and scientific advice to members.
- We have provided non-public releases in advance to members, with a specific licence.
- We have organized the first consortium committee meeting, at EDF (Clamart).
- Two engineers have been funded by the membership fees, for software engineering and software development, comparison with other solvers, business development and management of the consortium.

8.1.2. Contract with EMGS (Norway)

Following a strong interest from EMGS (Norway) in the latest evolutions of MUMPS (see Section 6.1) we worked on the third and final phase of a contract related to low-rank compression for electromagnetics applications in geophysics; the contract was managed by INP Toulouse.

8.2. Technological Transfer: XtremLogic Start-Up

The XTREMLOGIC start-up (former Zettice project) was initiated 4 years ago by Alexandru Plesco and Christophe Alias. The goal of XTREMLOGIC is to build on the state-of-the-art research results from the polyhedral community to provide the HPC market with efficient and communication-optimal circuit blocks (IP) for FPGA. The compiler technology transferred to XTREMLOGIC is the result of a tight collaboration between Christophe Alias and Alexandru Plesco.

XTREMLOGIC won several awards and grants: Rhône Développement Initiative 2015 (loan), "concours émergence OSEO 2013" at Banque Publique d'Investissement (grant), "most promising start-up award" at SAME 2013 (award), "lean Startup award" at Startup Weekend Lyon 2012 (award), "excel&rate award 2012" from Crealys incubation center (award).

SCALE Team (section vide)

<p style="text-align:center; color:red">SOCRATE Project-Team</p>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Socrate has strong collaboration with Orange Labs (point to point collaboration) and Alcatel Lucent through the Inria-ALU common lab and the GreenTouch initiative.

Socrate also works with Sigfox a important french young company deploying the first cellular network operator dedicated to M2M and IoT. A bilateral cooperation with sigfox supported the PhD of Minh Tien Do and continues with the PhD of Yuqi Mo. Socrate has also regular collaboration with HIKOB a start-up originated from the Citi laboratory providing sensor networks.

Socrate also collaborates with Euromedia group on advanced wireless techniques for sports events broadcasting systems.

7.1.1. Contractual Study - SigFox - "Standardization support" (2015-2016, 50 keuros)

SigFox is a French start-up deploying and exploiting a network for Internet of Things data collection. Their network is currently being deployed worldwide, and gaining more and more interest from customers. The network is based on a patented transmission protocol (Ultra Narrow Band and Random frequency multiple access), which is now entering standardisation process. The goal of this work is to support this standardization, by providing a deep analysis of the network performances.

7.1.2. CIFRE - SigFox - "Analysis and optimization of a bidirectional network based on UNB" (2015-2018, 50 keuros)

The goal of this thesis is to characterize and improve the network performance. To do so, the following tasks are envisioned:

1. retransmissions strategies to reach a targeted QoS;
2. feedback exploitation (acknowledgment);
3. coherent detection of signals provided by all the base stations (spatial diversity exploitation); and
4. nodes position estimation, and use of this knowledge in the access protocol.

SPIRALS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. ip-label

Participants: Christophe Ribeiro, Romain Rouvoy [correspondant].

A software exploitation license of the APISENSE® crowd-sensing platform has been sold to the ip-label company. They use this platform as a solution to monitor the quality of the GSM signal in the wild. The objective is to provide developers and stakeholders with a feedback on the quality of experience of GSM connection depending on their location.

8.2. Orange Labs

Participants: Laurence Duchien [correspondant], Amal Tahri.

This collaboration aims at bridging the gap between home networks and cloud environments for the design, the provisionning and the administration of distributed services. The purpose is to define solutions, essentially software design tools and runtime infrastructures, for the seamless migration of distributed applications and services between home networks and cloud environments. The envisioned approach is based on the research activities that we are conducting in the domain of software product lines.

This collaboration is conducted in the context of the ongoing PhD thesis of Amal Tahri.

8.3. Scalair

Participants: Yahya Al-Dhuraibi, Philippe Merle [correspondant].

This collaboration aims at proposing a framework to deal with elasticity in cloud computing environments. This framework must cover all kind of resources, IaaS, PaaS, SaaS, must provide a solution for interoperability between different clouds and virtualization technologies, and must enable the specification and composition of reactive and predictive strategies.

This collaboration is conducted in the context of the ongoing PhD thesis of Yahya Al-Dhuraibi.

STORM Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

CodePlay   A Contract has been established between CodePlay and Team Storm to experiment with the ComputeCpp compiler for the SYCL language and OpenCL based framework on hybrid, accelerated architectures.

8.2. Bilateral Grants with Industry

TOTAL SA   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   CEA is granting the CIFRE PhD thesis of Emmanuelle Saillard (2012-2015) on Static/Dynamic Analysis for the validation and optimization of parallel applications, Grégory Vaumourin (2013-2016) on Hybrid Memory Hierarchy and Dynamic data optimization for embedded parallel architectures, Emmanuel Cieren (2012-2015) on Molecular Dynamics on Exascale Supercomputers, and Jean-Charles Papin (2013-2016) on Potential-based Dynamic Scheduling techniques and Partitioning tools for domain decomposition simulations.

CEA - REGION AQUITAINE   CEA together with the Aquitaine Region Council is funding the PhD thesis of Marc Sergent (2013-2016) on Scalability for Task-based Runtimes.

RAPID HiBOX   This contract between IMACS an EADS France aims to develop a state of the art library for fast iterative, direct and hybrid methods, efficient on new heterogeneous parallel and hybrid architectures, that can be used on Boundary Element Methods. Applications targeted are acoustics, elastodynamics and electromagnetism. The contrat grants 2 year engineer for the parallelization of the library based on StarPU.

TACOMA Team (section vide)

TADAAM Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with CEA

CEA is granting the PhD thesis of Hugo Taboada on specialized thread management in the context of multi programming models, and the PhD thesis of Rémi Barat on multi-criteria graph partitioning.

7.2. Bilateral Grants with Bull/Atos

Bull/ATOS is granting the CIFRE PhD thesis on Nicolas Denoyelle on advanced memory hierarchies and new topologies.

7.3. Bilateral Grants with Onera

Onera is granting the PhD thesis of Raphaël Blanchard on the parallelization and data distribution of discontinuous Galerkin methods for complex flow simulations.

7.4. Bilateral Grants with EDF

EDF is granting the CIFRE PhD thesis of Benjamin Lorendeau on new programming models and optimization of Code Saturn.

URBANET Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- We have contracted bilateral cooperation with Rtone, an SME focusing on the connected objects area. This collaboration is associated with the CIFRE PhD grant for Alexis Duque, on the subject of Visible Light Communication.

- We have contracted bilateral cooperation with some industrial partners on the subject of smart casing. However, these contracts are under non disclosure agreements and cannot be mentioned here.

- We have contracted bilateral cooperation with industrial and academic partners in the context of the PSPC Fed4PMR project (2015-2018). In this context, we will be working on the design of new professional mobile radio solutions, compatible with 4G and 5G standards.

8.2. Bilateral Grants with Industry

- Common Laboratory Inria/Alcatel-Lucent Bell Labs - ADR Green.
  UrbaNet is part of the ADR Green of the common laboratory Inria/Alcatel-Lucent Bell Labs. This ADR provides the PhD grant of Soukaina Cherkaoui on the channel access capacity evaluation in 5G networks.

WHISPER Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Julia Lawall participates in the OSADL project SIL2LinuxMP (http://www.osadl.org/SIL2LinuxMP.sil2-linux-project.0.html). This project aims at the certification of the base components of an embedded GNU/Linux RTOS running on a single-core or multi-core industrial COTS computer board.

Together with Julien Sopena from REGAL, we are collaborating with Renault, in the context of the PhD of Antoine Blin (CIFRE), on hierarchical scheduling in multicore platforms for real-time embedded systems. This work is a dissemination of our previous research on the Bossa domain-specific language [6].

ALICE Project-Team (section vide)

ALPAGE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. 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 the following companies:

- Verbatim Analysis (license agreement, transfer agreement, "CIFRE" PhD (contract ended in Dec 2014), see section 4.3),
- Lingua et Machina (DTI-funded engineer, see section 4.4),
- viavoo (PhD of Marion Baranes, employed at viavoo, started in 2012 and defended in Oct 2015 about the automatic normalisation of noisy texts),
- Yseop ("CIFRE" PhD of Raphael Salmon started in 2012 about automatic text generation)
- CEA-List (PhD of Quentin Pradet on the annotation of semantic roles in specific domains (defense in Feb 2015).
- Proxem (consulting)

AVIZ Project-Team (section vide)

AYIN Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Airbus D&S

Participants: Paula Craciun, Josiane Zerubia [contact].

Automatic object tracking on a sequence of images taken from a geostationary satellite. Contract #7363.

8.1.2. L'OREAL Cosmétique Active International

Participants: Zhao Liu, Josiane Zerubia [contact].

Acne detection on images using a Markov random field model and chromophore descriptors extracted by bilateral decomposition. Contract #201514035.

8.2. Bilateral Grants with Industry

8.2.1. CNES Toulouse

Participants: Aurélie Boisbunon, Josiane Zerubia [contact].

Parameter estimation for automatic object change detection in a sequence of very high resolution optical images. Full post-doctoral grant funded by CNES, given to Aurélie Boisbunon during her 16 month stay in AYIN team.

Chroma Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Toyota Motors Europe*

[Feb 2006 - Feb 2009] [Dec 2010 - Dec 2015]

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.

8.1.2. *Renault*

[Jan 2010 - Feb 2013]

This contract was 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.

8.1.3. *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 "Embeeded 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).

<div align="center">

DAHU Project-Team

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7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

The CIFRE scholarship of David Montoya started in 2014, with Sinovia, Cofely Ineo (group GDF Suez). The topic is on analysis of multimodal itineraries and the integration of itinerary data with other personal data.

DEFROST Team (section vide)

DREAM Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *SocTrace: analysis of SOC traces*

Participants: Serge Vladimir Emteu Tchagou, Alexandre Termier.

SoCTrace is a FUI project led by STMicroelectronics, with the companies ProbaYes and Magilem, Université Joseph Fourier and Inria Rhône-Alpes. Its goal is to provide an integrated environment for storing and analyzing execution traces. In this project, we are working on data mining techniques for analyzing the traces, and on the use of ontologies to enable querying traces with a higher level of abstraction.

8.1.2. *ITRAMI: Interactive Trace Mining*

Participants: Alexandre Termier, Thomas Guyet, René Quiniou.

ITRAMI is a Nano2017 project. Such projects are designed to support joint research efforts between STMicrolectronics and academic partners in the domain of embedded systems. Alexandre Termier is the PI of this projet, having for goal to design novel data mining methods for interactive analysis of execution traces. Such methods aim at considerably reducing the time that STMicroelectronics developers spend at understanding, debugging and profiling applications running on STMicrolectronics chips. The project work is done at University Joseph Fourier (Grenoble), in collaboration with DREAM researchers Thomas Guyet and René Quiniou. Two contractual personnel are working on the project in Grenoble: Willy Ugarte as a postdoc, and Soumay Ben Alouane as an engineer.

EX-SITU Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

MultiHub (Microsoft donation, 2015-2016) – ExSitu was one of the ten academic institutions world wide awarded a hardware and monetary grant by Microsoft Research as part of its request for proposal to expand the potential applications of the Surface Hub across all aspects of society (http://research.microsoft.com/en-us/projects/surface-hub/). The goal of the MultiHub project is to enable interaction in the large, where groups of experts can interact with rich content and complex data while collaborating both locally and remotely in interactive, multi-surface environments. ExSitu was awarded two 55" Surface Hubs and $19,000 in cash.

8. Bilateral Contracts and Grants with Industry

8.1. Collaboration with Meaning engines

EXMO collaborates with the meaning engine start-up company whose goal is to help improve the knowledge of corporate knowledge, e.g., catalogs, costumer data, through linked data principles (the application of semantic web technology for publishing data). Among their prospective costumers are music aggregators as well as banks. We have benefited from the position of Nicolas Guillouet for developing generic connectors based on our Alignment API. They introduce two novel features: using the notion of link keys to identify identical items in a data flow and performing hybrid integration which either identifies or creates objects from the incoming flows. In fact, hybrid integration is a type of knowledge evolution that provides new interesting research problems.

<p style="text-align:center; color:red; font-weight:bold;">FLOWERS Project-Team</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Advanced platform for Urban Mobility (PAMU)

Participants: David Filliat [correspondant], Emmanuel Battesti.

We further developed a planning algorithm for a autonomous electric car for Renault SAS. We improved a planning module in order to produce global plans to reach a goal specified in a digital map and to perform local reactive planning to avoid dynamic obstacles. This module is integrated in the PAMU autonomous vallet parking developed by Renault with several academic partners. A milestone demonstration of the system was made at the 22nd ITS World Congress, in Bordeaux, on the 5-9 October 2015.

8.2. Bilateral Grants with Industry

8.2.1. Development of an Contextual electronic copilot for driving assistance

Participants: David Filliat [correspondant], Alexandre Armand.

Financing of the CIFRE PhD grant of Alexandre Armand by Renault SAS with the goal of developping an Contextual electronic copilot for driving assistance based on the learning of the behavior of the driver.

8.2.2. Curiosity and visual attention

Participants: David Filliat [correspondant], Celine Craye.

Financing of the CIFRE PhD grant of Celine Craye by Thales S.A. with the goal of developing a mechanism of visual attention guiding the exploration of a robot.

8.2.3. Auto-Apprentissage Auto-Adaptable pour la compliance au traitement

Participants: Manuel Lopes [correspondant], Alexandra Delmas, Pierre-Yves Oudeyer, Benjamin Clement.

Financing of the CIFRE PhD grant of Alexandra Delmas by Itwell with the goal of developing a tool for self-learning for patients to improve their compliance to treatment.

GRAPHDECO Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

We received a donation from Adobe research in the context of the collaboration with W. Li and a donation from Technicolor for a new collaboration which will start in 2016 on image manipulation.

We collaborate extensively with Testaluna SA, and other game companies in the context of the CR-PLAY EU project.

We have started a Regional Ph.D. these with the local company Kaleidoscope (Toulon).

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. CTFC

Participants: Patrice Buche, Jérôme Fortin.

In 2015, we relied on our collaboration with the technical center of Comptois' cheese (CTFC : Centre Technique des Fromages Comtois), initiated in the previous years, to build an enlarged project involving different traditional food chains (CNAOL, Conseil National des Appelations d'Origine Laitière). The aim of this project is to develop a platform that will be used in traditional cheese processing for expert knowledge management. This project was pre-selected by the French Ministry of agriculture but finally not accepted, hence we are working on a new version.

8.1.2. ABES

Participants: Michel Leclère, Michel Chein.

See results in Section 7.3 and the ANR project Qualinca in Section 9.1 .

HEPHAISTOS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Participant: Yves Papegay.

We had a short-term collaboration with the Exelsius company devoted to innovative solutions in processes of electronic business and namely conformal coating. Path-planning algorithms have been designed for inclusion in a new machine for selective surface activation based on atmospheric pressure plasma. Transfer of know-how has been covered by a research contract, and by a technology cession.

8.2. Bilateral Grants with Industry

Participant: Jean-Pierre Merlet.

We have got a grant from the company GénérationRobot to develop a pedagogical cable-driven parallel robot

<div align="center">**HYBRID Project-Team**</div>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Mensia Technologies*

Participants: Anatole Lécuyer, Jussi Lindgren.

Mensia Technologies is an Inria start-up company created in November 2012 as a spin-off of Hybrid team. Mensia is focused on wellness and healthcare applications emerging from the BCI and Neurofeedback technologies. The Mensia startup should benefit from the team's expertise and of valuable and proprietary BCI research results. Mensia is based in Rennes and Paris. Anatole Lécuyer and Yann Renard (former Inria expert engineer who designed the OpenViBE software architecture and was involved in team projects for 5 years) are co-founders of Mensia Technologies together with CEO Jean-Yves Quentel.

The on-going contract between Hybrid and Mensia started in November 2013 and supported the transfer of several softwares designed by Hybrid team ("OpenViBE", "StateFinder") related to our BCI activity and our OpenViBE software (section 6.1) to Mensia Technologies for 5 years, for future multimedia or medical applications of Mensia.

8.1.2. *MBA Multimedia*

Participants: Ferran Argelaguet Sanz, Maud Marchal, Anatole Lécuyer.

This on-going contract started in June 2013 and supported the transfer of several softwares designed by Hybrid team (e.g., "Elastic Images") in the frame of the W3D project to MBA Multimédia company for future applications in the field of multimedia and web design based mainly on HTML5 and Word Press software.

8.1.3. *Polymorph Studio*

Participants: Ferran Argelaguet Sanz, Maud Marchal, Anatole Lécuyer.

This on-going contract started in June 2013 and supported the transfer of several softwares designed by Hybrid team (e.g., "Pseudo-haptik", "Elastic Images") in the frame of the W3D project to Polymorph Studio company for future applications in the field of multimedia and web design based mainly on Unity3D software.

8.2. Bilateral Grants with Industry

8.2.1. *Technicolor*

Participants: Antoine Costes, Anatole Lécuyer, Ferran Argelaguet.

This grant started in December 2015. It supports Antoine Costes's CIFRE PhD program with Technicolor company on "Haptic Texturing".

8.2.2. *Realyz*

Participants: Guillaume Cortes, Anatole Lécuyer.

This grant started in December 2015. It supports Guillaume Cortes's CIFRE PhD program with Realyz company on "Improving tracking in VR".

8.2.3. *VINCI*

Participants: Anne-Solène Dris-Kerdreux, Bruno Arnaldi, Valérie Gouranton.

This grant started in November 2015. It supports Anne-Solene Dris-Kerdreux's CIFRE PhD program with Vinci company on "Training in VR for construction applications".

ILDA Team (section vide)

IMAGINE Project-Team (section vide)

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LAGADIC Project-Team

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8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Robocortex

Participants: Souriya Trinh, Fabien Spindler, François Chaumette.

no. Inria Rennes 8492, duration: 22 months.

This contract with the Inria spin off company Robocortex started in March 2014. It is devoted to the visual tracking and 3D localization of some particular targets.

8.2. Bilateral Grants with Industry

8.2.1. Astrium EADS

Participants: Tawsif Gokhool, Patrick Rives.

no. Inria Sophia 7128, duration: 36 months.

The objective of this project that started in February 2012 was to investigate the general problem of visual mapping of complex 3D environments that evolve over time. This contract supported Tawsif Gokhool's Ph.D. (see Section 7.4.3).

8.2.2. ECA Robotics

Participants: Romain Drouilly, Patrick Rives.

no. Inria Sophia 7030, duration: 36 months.

This project started in May 2012. It aimed at specifying a semantic representation well adapted to the problem of navigation in structured environment (indoors or outdoors). This contract was devoted to support the Cifre Convention between ECA Robotics and Inria Sophia Antipolis regarding Romain Drouilly's Ph.D. (see Section 7.4.5).

8.2.3. Technicolor

Participants: Salma Jiddi, Eric Marchand.

Univ. Rennes 1, duration: 36 months.

This project funded by Technicolor started in October 2015. It supports Salma Jiddi's Ph.D. about augmented reality.

8.2.4. Pôle Saint Hélier

Participants: Louise Devigne, Marie Babel.

no. Insa Rennes 2015/0890, duration: 36 months.

This project started in November 2015. It will address the following two issues. First, the idea is to design a low-cost indoor / outdoor efficient obstacle avoidance system that respects the user intention, and does not alter user perception. This involves embedding innovative sensors to tackle the outdoor wheelchair navigation problem. The second objective is to take advantage of the proposed assistive tool to enhance the user Quality of Experience by means of biofeedback as well as the understanding of the evolution of the pathology.

<p align="center" style="color:red">LARSEN Team</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Emiota

Participant: Jean-Baptiste Mouret.

- Company: Emiota (http://www.wearbelty.com/ / http://www.emiota.fr/)
- Duration: 03/2015 – 12/2015
- Abstract: Emiota is a startup that works on a "smart" belt: a motorized and sensorized belt that both senses bio-medical data and adapts its length to the activity of its holder. For instance, the belt could tighten if it detects that its holder is getting up and relax if he sits down. In this contract, the Larsen team demonstrated how Bayesian optimization and Gaussian processes, two machine learning techniques used in our recent Nature paper [11], can be used to achieve this adaptation.

<p style="text-align:center">**LEAR Project-Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. MBDA

Participants: Jakob Verbeek, Julien Bardonnet.

Since 2004 we have collaborated with MBDA on a variety of subjects, namely object detection, tracking and matching. Several PhD students have been funded by MBDA, and code has been transferred which is integrated in products. Our collaboration resulted in 2010 in the award of the MBDA prize for innovation. Since May 2015 we have one engineer funded by MBDA working on incremental learning of object detection models. The goal is to take pre-existing vehicle models, and to quickly adapt them to new images of these vehicles when they are acquired in the field.

8.2. Google

Participants: Karteek Alahari, Cordelia Schmid.

We received a Google Faculty Research Award in 2015. The objective is to interpret video semantically in the presence of weak supervision. We will focus on answering questions such as *who* is in the scene, *what* they are doing, and *when* exactly did they perform their action(s). We propose to develop models for detection and recognition of objects and actions learned from minimally annotated training data.

8.3. Facebook

Participants: Cordelia Schmid, Jakob Verbeek, Karteek Alahari, Julien Mairal.

End of 2015 we received a gift from Facebook. The collaboration will start in 2016. The topics include image retrieval with CNN based descriptors, weakly supervised semantic segmentation, and learning structure models for action recognition in videos.

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

Participants: Anoop Cherian, Zaid Harchaoui, Yang Hua, Cordelia Schmid, Karteek Alahari.

This collaborative project, which started in 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. Yang Hua is funded by this project.

8.5. MSR-Inria joint lab: structured large-scale machine learning

Participants: Julien Mairal, Zaid Harchaoui.

Machine learning is now ubiquitous in industry, science, engineering, and personal life. While early successes were obtained by applying off-the-shelf techniques, there are two main challeges faced by machine learning in the « big data » era : structure and scale. The project proposes to explore three axes, from theoretical, algorithmic and practical perspectives: (1) large-scale convex optimization, (2) large-scale combinatorial optimization and (3) sequential decision making for structured data. The project involves two Inria sites and four MSR sites and started at the end of 2013.

8.6. Xerox Research Center Europe

Participants: Zaid Harchaoui, Mattis Paulin, Karteek Alahari, Vladyslav Sydorov, Cordelia Schmid.

The collaboration with Xerox has been on-going since October 2009 with two co-supervised CIFRE scholarships (2009–2012; 2011-2014). Starting June 2014 we signed a third collaborative agreement for a duration of three years. The goal is to develop approaches for deep learning based image description and pose estimation in videos.

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Teddy Furon spent 20 % of his time during 6 months to transfer research result to IRT B-com

CIFRE Ph. D. contract with Institut National de l'Audiovisuel (Bingqing Qu)

CIFRE Ph. D. contract with Technicolor (Himalaya Jain)

Ph. D. contract with Alcatel-Lucent Bell Labs (Raghavendran Balu) in the framework of the joint Inria-Alcatel Lucent lab.

LINKS Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

Innovimax is founding the PhD thesis of Tom SEBASTIAN (2011-15). The thesis is supervised by J.NIEHREN in cooperation with M.ZERGAOUI the head of the INNOVIMAX company. The software development in this context is supported by T. SEBASTIAN.

<p style="text-align:center; color:red;">**MAGNET Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. KeyCoopt (2015)

Participants: Rémi Gilleron [correspondent], François Noyez, Fabien Torre.

We have a bilateral contract with the KEYCOOPT company. The goal of the company is to suggest candidates for job offers. For this, the company has a large pool of referrers, also named coopters. The process is: given a job offer, some coopters are selected, each coopter may suggest a candidate, the proposed candidates are selected by KEYCOOPT and some candidates are proposed in answer to the job offer. We propose a machine learning based method for selecting coopters given a job offer. The method is a ranking algorithm using support vector machines (SVMRank). It has been developed and tested and can be integrated in the information system of KEYCOOPT. Possible improvements are to use natural language processing methods in order to use texts as texts for job offers, and to use the network of coopters.

8.2. Bilateral Grants with Industry

8.2.1. Cifre Clic and Walk (2013-2016)

Participants: Mikaela Keller [correspondent], Pauline Wauquier, Marc Tommasi.

We have a one to one cooperation with the CLIC AND WALK company that makes marketing surveys by consumers (called clicwalkers). The goal of the company is to understand the community of clicwalkers (40 thousands in one year) and its evolution with two objectives: the first one is to optimize the attribution of surveys to clicwalkers, and the second is to expand company's market to foreign countries. Social data can be obtained from social networks (G+, Facebook, ...) but there is no explicit network to describe the clicwalkers community. But users activity in answering surveys as well as server logs can provide traces of information diffusion, geolocation data, temporal data, sponsorship, etc. We will study the problem of adaptive graph construction from the clicwalkers network. Node (users) classification and clustering algorithms will be applied. For the problem of survey recommendations, the problem of teams constitution in a bipartite graphs of users and surveys will be studied. Random graph modeling and generative models of random graphs will be one step towards the prediction of the evolution of clicwalkers community.

8.2.2. Cifre SAP (2011-2014)

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

The PhD defense of Thomas Ricatte was held in Lille on January 23th 2015.

<p style="text-align: center; color: red;">**MAGRIT Project-Team**</p>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

The partnership with GE Healthcare started in 1993. In the past few years, it bore on the supervision of CIFRE PhD fellows on the topic of using a multi-modal framework and augmented reality in interventional neuroradiology. The PhD thesis of Charlotte Delmas started in April 2013 with the aim to perform 3D reconstruction of tools in interventional neuroradiology. Our goal is to help clinical gesture by providing the physician with a better understanding of the relative positions of the tools and of the pathology.

MANAO Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- CIFRE PhD contract with Technicolor 2 (2014-2018)
  Participants: A. Dufay, X. Granier, and R. Pacanowski
  For this project, we aim at providing interactive previsualization of complex lighting with a smooth transition to the final solution.

MAVERICK Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

WetaFX (New-Zealand) has given us 30,000 euros in 2015, as a unilateral gift.

<p style="text-align:center; color:red;">**MIMETIC Project-Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Visual Analytics for Cinematographic Data*
Participant: Marc Christie [contact].

The contract has two objectives: first developping a film annotation tool that integrates cinematographic image and editing features such as visual composition, shot type, balance, depth, shot transition, etc. While existing annotation tools such as Anvil and Elan are are largely used for film annotation, the specificities of cinematographic and editing features requires the design of dedicated tools which mix automated and manual annotation stages. The work builds on the Insight annotation tool developed in our group (see [29]).

The second objective is to provide means to visualize and interact with the data, following the general trend of Visual Analytics. Different representations are currently explored and developped inside Technicolor's internal tools.

8.2. Bilateral Grants with Industry

8.2.1. *Cifre Faurecia*
Participant: Franck Multon [contact].

This contract aims at developing new ergonomics assessments based on inaccurate Kinect measurements in manufactures on real workers. The main challenges are:

- being able to improve the Microsoft Kinect measurement in order to extract accurate poses from depth images while occlusions may occur,
- developing new inverse dynamics methods based on such inaccurate kinematic data in order to estimate the joint torques required to perform the observed task,
- and proposing a new assessment tool to translate joint torques and poses into potential musculoskeletal disorders risks.

Faurecia has developed its own assessment tool but it requires tedious and subjective tasks for the user, at specific times in the work cycle. By using Kinect information we aim at providing more objective data over the whole cycle not only for specific times. We also wish to make the user focus on the interpretation and understanding of the operator's tasks instead of taking time estimating joint angles in images.

This work is performed in close collaboration with an ergonomist in Faurecia together with the software development service of the company to design the new version of their assessment tool. This tool will be first evaluated on a selection of manufacture sites and will then be spread worldwide among the 300 Faurecia sites in 33 countries.

This contract enabled us to hire Pierre Plantard as a PhD student to carry-out this work in MimeTIC and M2S Lab. He started in January 2013 and will finish in January 2016.

MINT Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. *Ayodyo (10 Keuros) (sept. 2015-mar 2016)*

Embedded software tools for movement-enriched musical instrument. 10 Keuros contract.

7.1.2. *Holusion (15 Keuros) (jan-mar 2015)*

STAR on holographic displays, and methodological recommendations for interaction design and HCI principles.

7.1.3. *Bipolar-production (3 Keuros), nov. 2015-fev. 2016*

Licence for a software result issued from Y. Rekik thesis (multi-touch public interaction, software aiming at strengthening tactile interaction)

Mjolnir Team (section vide)

MORPHEO Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. QuickCSG Contract with undisclosed industrial partner

QuickCSG software was licensed in october 2015 to an industrial partner whose name is contractually kept undisclosed for a finite time period. QuickCSG is being integrated into the partner's software and is scheduled to be sold with this industrial partner's products during the year of 2016. An additional support contract has been signed with this partner for the purpose of the transfer.

<p align="center" style="color:red">MULTISPEECH Project-Team</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. MAIA

Company: Studio MAIA

Duration: September 2014 - August 2015

Supported by: Bpifrance

Abstract: A pre-study contract was signed to investigate speech processing tools that could eventually be transferred as plugins for audio mixing software. Prosody modification, noise reduction, and voice conversion are of special interest.

8.1.2. Venathec

Company: Venathec SAS

Other partners: ACOEM Group, GE Intelligent Platforms (contracted directly with Venathec)

Duration: June 2014 - August 2017

Supported by: Bpifrance

Abstract: The project aims to design a real-time control system for wind farms that will maximize energy production while limiting sound nuisance. This will leverage our know-how on audio source separation and uncertainty modeling and propagation.

OAK Project-Team (section vide)

ORPAILLEUR Project-Team (section vide)

PANAMA Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Research contract with TDF
Participants: Nancy Bertin, Ewen Camberlein, Rémi Gribonval.

Duration: 6 weeks

Partners: TDF

This contract aimed at conceiving an algorithm to estimate the time offset between to identical or similar audio streams, to implement this algorithm in a prototype and to benchmark it on test files provided by the partner.

8.2. Bilateral Grants with Industry

8.2.1. CIFRE contract with Technicolor R&I France on Very large scale visual comparison
Participants: Rémi Gribonval, Himalaya Jain.

Duration: 3 years (2015-2018)

Research axis: 3.1.2

Partners: Technicolor R&I France, Inria-Rennes

Funding: Technicolor R&I France, ANRT

The grand goal of this thesis is to design, analyze and test new tools to allow large-scale comparison of high-dimensional visual signatures. Leveraging state of the art visual descriptors, the objective is to obtain new compact codes for visual representations, exploiting sparsity and learning, so that they can be stored and compared in an efficient, yet meaningful, way.

<p style="text-align:center">**PERCEPTION Project-Team**</p>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

In 2015 we started a collaboration with Xerox Research Center India (XRCI), Bangalore. This three-year collaboration (2015-2017) is funded by a grant awarded by the **Xerox Foundation University Affairs Committee (UAC)** and the topic of the project is *Advanced and Scalable Graph Signal Processing Techniques*. The work is done in collaboration with EPI MISTIS and our Indian collaborators are Arijit Biswas and Anirban Mondal.

<p style="text-align:center">**POTIOC Project-Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Interactive Collaboration in Virtual Reality for Aerospace Scenarii:

- duration: 2014-2017
- PhD Thesis of Damien Clergeaud
- partners: Airbus Group
- The Airbus company regularly uses virtual reality for design, manufacturing and maintenance (see Figure 14). We work with them on collaborative interaction in order to enable an efficient collaboration between operators immersed in the virtual environment from remote locations and with heterogeneous equipment. More precisely, we have developed tools to point and manipulate objects, to remotely visualize the virtual environment, to be aware of remote manipulations and to describe tools and components trajectories.
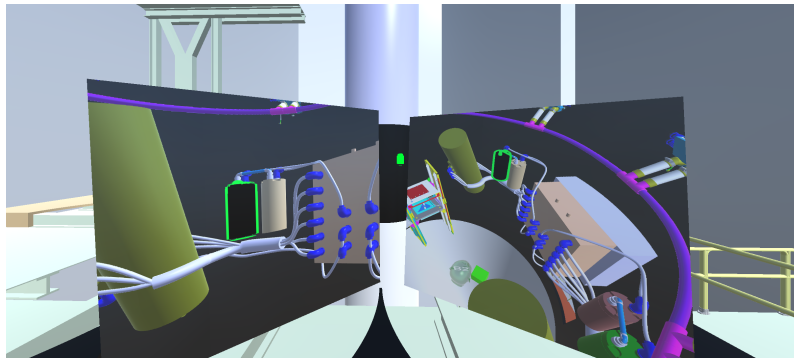

Figure 14. Example of a tool which allows to be aware of a remote place in a virtual reality application (Airbus collaboration)

<p style="text-align:center; color:red;">**PRIMA Project-Team**</p>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. *Far-Infrared Visual Sensors*

PRIMA has worked with Schneider Electric on embedded image analysis algorithms for a new generation of far-infrared visual sensors. The objective is to develop an integrated visual sensor with very low power consumption. Such systems can be used to estimate temperature in different parts of a room, as well as to provide information about human presence and human activity.

7.1.2. *Learning Routines in a Smart Home*

PRIMA is working with Orange Labs on techniques for observing activity and learning routines in a smart home. Activity is observed by monitoring use of electrical appliances and Communications media (Telephone, Television, Internet). Activities are described using Bayesian Situation Modelling techniques demonstrated in earlier projects. A log of daily activities is used to discover daily routines expressed as temporal sequences of contexts, where each context is expressed as a network of situations.

Experiments will be performed using the LovelyLoft Smart home living lab that has been constructed as part of the EquipEx Amiqual4home.

RITS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Valeo Group: a very strong partnership is under reinforcement between Valeo and Inria. Several bilateral contracts were signed to conduct joint works on Driving Assistance. Valeo financed the PhD thesis of G. Trehard under the framework of Valeo internal project "V50" and is currently a major financing partner of the "GAT" international Chaire / JointLab. Technology transfer is also a major collaboration topic between RITS and Valeo.

SEMAGRAMME Project-Team (section vide)

<p align="center" style="color:red">SIROCCO Project-Team</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

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

Participants: Christine Guillemot, Bihong Huang.

- Title : Generalized lifting for video compression.
- Research axis : § 7.3.2 .
- Partners : Orange Labs, Inria-Rennes, UPC-Barcelona.
- Funding : Orange Labs.
- Period : Apr.2012-Mar.2015.

This contract with Orange labs. (started in April. 2012) concerns the PhD of Bihong Huang and aims at modelling the redundancy which remains in spatial and temporal prediction residues. The analysis carried out in the first year of the PhD has shown that this redundancy (hence the potential rate saving) is high. In 2013, different methods have been investigated to remove this redundancy, such as generalized lifting and different types of predictors. 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 (Prof. Philippe Salembier) in Barcelona.

8.1.2. CIFRE contract with Technicolor on High Dynamic Range (HDR) video compression

Participants: Mikael Le Pendu, Christine Guillemot.

- Title : Floating point high dynamic range (HDR) video compression
- Research axis : § 7.3.4 .
- Partners : Technicolor, Inria-Rennes.
- Funding : Technicolor, ANRT.
- Period : Dec.2012-Nov.2015.

High Dynamic Range (HDR) images contain more intensity levels than traditional image formats, leading to higher volumes of data. HDR images can represent more accurately the range of intensity levels found in real scenes, from direct sunlight to faint starlight. The goal of the thesis is to design a visually lossless compression algorithm for HDR floating-point imaging data. The first year of the thesis has been dedicated to the design of a quantization method converting the floating point data into a reduced bit depth representation, with minimal loss. The method leads to a bit rate saving of 50% compared to the existing Adaptive LogLuv transform.

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

Participants: Martin Alain, Christine Guillemot.

- Title : Spatio-temporal analysis and characterization of video scenes
- Research axis : § 7.1.2 .
- Partners : Technicolor, Inria-Rennes.
- Funding : Technicolor, ANRT.
- Period : Oct.2012-Sept.2015.

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 using models based on sparse and data dimensionality reduction techniques, as well as based on epitomes. The objective was then to use these models and methods in different image processing problems focusing in particular on video compression. While, 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 started in Oct. 2012 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 denoising and super-resolution.

8.1.4. 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 pre-analysis approaches.
- Research axis : § 7.3.5 .
- Partners : Thomson Video Networks, Univ. Rennes 1.
- Funding : Thomson Video Networks (TVN).
- Period : Nov.2012-Sept.2015.

This contract with TVN (started 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 thanks to a pre-analysis step. The pre-analysis is expected to provide useful estimates of local video characteristics which will then help selecting the prediction and transform partitions as well as a number of other parameters such as the quantization parameters or the prediction modes.

8.1.5. CIFRE contract with Envivio on LDR compatible HDR video coding

Participants: Christine Guillemot, David Gommelet, Aline Roumy.

- Title : LDR-compatible coding of HDR video signals.
- Research axis : § 7.3.3 .
- Partners : Envivio.
- Funding : Cifre Envivio.
- Period : Oct.2014-Sept.2017.

The goal of this Cifre contract is to design solutions for LDR-compatible coding of HDR videos. This involves the study of rate-distortion optimized tone mapping operators taking into account constraints of temporal coherency to avoid the temporal flickering which results from a direct frame-by-frame application of classical tone mapping operators. The goal is also to design a coding architecture which will build upon these operators, integrating coding tools tailored to the statistics of the HDR refinement signals.

8.1.6. CIFRE contract with Technicolor on light fields editing

Participants: Christine Guillemot, Matthieu Hog.

- Title : Light fields editing
- Research axis : *just started*
- Partners : Technicolor, Inria-Rennes.
- Funding : Technicolor, ANRT.
- Period : Oct.2015-Sept.2018.

Editing is quite common with classical imaging. Now, if we want light-fields cameras to be in the future as common as traditional cameras, this functionality should also be enabled with light-fields. The goal of the PhD will therefore be to develop methods for light-field editing focusing first on object removal thanks to light-fields inpainting and for constructing panoramic images based on light-fields stitching. This objective also includes the development of algorithms for dynamic light fields spatio-temporal segmentation with spatio-temporal coherence constraints across sub-aperture images.

8.1.7. CIFRE contract with Technicolor on cloud-based video compression

Participants: Jean Begaint, Christine Guillemot.

- Title : Cloud-based video compression
- Research axis : *just started*
- Partners : Technicolor, Inria-Rennes.
- Funding : Technicolor, ANRT.
- Period : Nov.2015-Oct.2018.

The goal of this Cifre contract is to develop a novel image compression scheme exploiting similarity between images in a cloud. The objective will therefore be to develop rate-distortion optimized affine or homographic estimation and compensation methods which will allow us to construct prediction schemes and learn adapted bases from most similar images retrieved by image descriptors. One issue to be addressed is the rate-distortion trade-off induced by the need for transmitting image descriptors.

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 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. While no bilateral contract exists between Gemalto and SMIS, we are partners in several projects. Meanwhile, we are developing partnerships with SMEs capable of building ad-hoc hardware prototypes conforming to our own design.

7.1.1. Cozy Cloud bilateral contract (Dec 2014 - Nov. 2015)

Partners: Cozy Cloud, Inria-SMIS
SMIS funding: 50k€.
Many personal data end up today on servers where they can be scrutinized by companies and governmental agencies. To face this situation, the most emblematic initiative is the Personal Cloud paradigm. Roughly speaking, the Personal Cloud is an architecture which gives users the ability to store their complete digital environment, synchronize it among various devices and share it with other users and applications under their control. It reflects the expectation of the individuals for the emergence of privacy-by-design next-generation storage and computing services. Cozy Cloud is a French startup providing such a personal Cloud platform. The Cozy product is a software stack that anyone can deploy to run his personal server in order to host his personal data and web services. Cozy defines itself as the "Android of personal servers". While centralizing all personal data in the holder's hand is a natural way to reestablish his control on his privacy, this represents an unprecedented threat in case of attacks by an intruder, especially for individuals who are not security experts. The objective of this bilateral contract is typically to address this issue by integrating the PlugDB solution into the Cozy stack. Roughly speaking, the Cozy data system will be modified in such a way to store only encrypted files and each file access will be intercepted and routed to PlugDB. PlugDB will act as a doorkeeper for the whole individual dataspace by managing the files' metadata, the access control rules defined on these metadata, the decryption keys and the user/application authentication.

7.1.2. Cozy Cloud CIFRE contract (Oct 2014 - Sept 2017)

Partners: Cozy Cloud, Inria-SMIS
SMIS funding: 30k€.
In relation with the bilateral contract mentioned above, a CIFRE PhD thesis has been started by Paul Tran Van. The objective is to capitalize on the Cozy-PlugDB platform to devise new access and usage control models to exchange data among devices of the same user (devices may have different levels of trustworthiness) and among different users. A particular focus will be put on the enforcement of the access and usage control rules in this thesis.

STARS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- **Toyota Europ**: this project with Toyota runs from the 1st of August 2013 up to 2017 (4 years). It aims at detecting critical situations in the daily life of older adults living home alone. We believe that a system that is able to detect potentially dangerous situations will give peace of mind to frail older people as well as to their caregivers. This will require not only recognition of ADLs but also an evaluation of the way and timing in which they are being carried out. The system we want to develop is intended to help them and their relatives to feel more comfortable because they know potentially dangerous situations will be detected and reported to caregivers if necessary. The system is intended to work with a Partner Robot (to send real-time information to the robot) to better interact with older adults.

- **LinkCareServices**: this project with Link Care Services runs from 2010 upto 2015. It aims at designing a novel system for Fall Detection. This study consists in evaluating the performance of video-based systems for Fall Detection in a large variety of situations. Another goal is to design a novel approach based on RGBD sensors with very low rate of false alarms.

<p style="text-align:center">**TITANE Project-Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Astrium*
Participants: Sven Oesau, Florent Lafarge, Pierre Alliez.

The main goal of this collaboration is to devise new algorithms for reconstructing 3D indoor models that are 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 devising more complex geometric entities adapted to a detailed and semantized description of scenes.

- Starting date: April 2012

- Duration: 3 years

8.1.2. *Geoimage*
Participants: Liuyun Duan, Florent Lafarge.

The aim of this collaboration is to devise a new type of 2.5D representation from satellite multi-view stereo images which is more accurate, compact and meaningful than the conventional DEMs. A key direction consists in incorporating semantic information directly during the image matching process. This semantic information is related to the type of components of the scene, such as vegetation, roofs, building edges, roads and land.

- Starting date: November 2013

- Duration: 3 years

8.1.3. *CSTB*
Participants: Sven Oesau, Florent Lafarge.

The goal of this collaboration is to consolidate and integrate research codes implemented in Titane for urban semantization and reconstruction, into the CSTB reconstruction framework.

- Starting date: September 2015

- Duration: 6 months

8.2. Bilateral Grants with Industry

8.2.1. *CNES Toulouse*
Participants: Emmanuel Maggiori, Yuliya Tarabalka [PI].

Hierarchical approaches for object-oriented classification of multi-source images. Contract 150490/00.

- Starting date: November 2015

- Duration: 2 years

TYREX Project-Team (section vide)

WILLOW Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Facebook AI Research Paris: Weakly-supervised interpretation of image and video data (Inria)

Participants: Jean Ponce, Minsu Cho, Ivan Laptev, Josef Sivic.

We will develop in this project (Facebook gift) new models of image and video content, as well as new recognition architectures and algorithms, to address the problem of understanding the visual content of images and videos using weak forms of supervision, such as the fact that multiple images contain instances of the same objects, or the textual information available in television or film scripts.

8.2. Google: Learning to annotate videos from movie scripts (Inria)

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.

8.3. Google: Structured learning from video and natural language (Inria)

Participants: Simon Lacoste-Julien, Ivan Laptev, Josef Sivic.

People can easily learn how to change a flat tire of a car or assemble an IKEA shelve by observing other people doing the same task, for example, by watching a narrated instruction video. In addition, they can easily perform the same task in a different context, for example, at their home. This involves advanced visual intelligence abilities such as recognition of objects and their function as well as interpreting sequences of human actions that achieve a specific task. However, currently there is no artificial system with a similar cognitive visual competence. The goal of this proposal is to develop models, representations and learning algorithms for automatic understanding of complex human activities from videos narrated with natural language.

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

Participants: Leon Bottou [Facebook], Ivan Laptev, Maxime Oquab, Jean Ponce, Josef Sivic, Cordelia Schmid [Inria Lear].

This collaborative project 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.

In October 2013 a new agreement has been signed for 2013-2016 with the research focus on automatic understanding of dynamic video content. Recent studies predict that by 2018 video will account for 80-90% of traffic on the Internet. Automatic understanding and interpretation of video content is a key enabling factor for a range of practical applications such as organizing and searching home videos or content aware video advertising. For example, interpreting videos of "making a birthday cake" or "planting a tree" could provide effective means for advertising products in local grocery stores or garden centers. The goal of this project is to perform fundamental computer science research in computer vision and machine learning in order to enhance the current capabilities to automatically understand, search and organize dynamic video content.

WIMMICS Project-Team (section vide)

<p style="text-align:center;color:red;font-weight:bold;">ZENITH Project-Team</p>

8. Bilateral Contracts and Grants with Industry

8.1. Microsoft (2013-2017)

Participants: Ji Liu, Esther Pacitti, Patrick Valduriez.

This joint project is on advanced data storage and processing for cloud workflows with the Kerdata team in the context of the Joint Inria – Microsoft Research Centre. The project addresses the problem of advanced data storage and processing for supporting scientific workflows in the cloud. The goal is to design and implement a framework for the efficient processing of scientific workflows in clouds. The validation h will be performed using synthetic benchmarks and real-life applications from bioinformatics: first on the Grid5000 platform in a preliminary phase, then on the Microsoft Azure cloud environment.

8.2. Triton I-lab (2014-2016)

Participants: David Fernandez, Houssem-Eddine Chihoud, Didier Parigot.

Triton is a new common lab. (i-lab) created between Zenith and Beepeers (http://beepeers.com) to work on a platform for developing social networks in mobile/Web environments. The main objective of this project is to design and implement a new architecture for beepeers applications to move to the scale. This new architecture will build on our SON middleware and new NoSQL database technologies, especially graph databases.