Activity Report 2013

Section Partnerships and Cooperations

ACES Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. Bin That Thinks

- Partners: ACES (Inria Rennes) and POPS (Inria Lilles), Veolia Propreté, and Etineo (a start up company focused on M2M communications and ambient networking)
- Starting: November 2010; ending: December 2013

BinThatThinks is an ANR project funded by the ANR Ecotech program, that is ended in December 2013. It aimed at sorting domestic waste at early stage in order to reduce costs and risks in waste sorting center, as well as helping citizens to adopt environment respectful. To this end, Bin That Think introduced a new system for (1) identifying the waste which involve a reject during waste collection, (2) detecting incompatible products and (3) implementing a reporting infrastructure enabling an efficient management/planning of the waste collecting process.

An infrastructure of smart bins was designed. This infrastructure leverage on waste identification mechanism based on self describing objects, helping user to sort their waste correctly, using either QR codes or RFID technologies. Wastes are grouped in smart bags, that can be read to determine their content. A given bin can accept or rejet wastes depending on the sorting policy, or to prevent hazardous conditions to happen. Waste identification and wastes/bins interactions were the main focus of ACES in the project. The second important aspect of the project is the communication infrastructure, which was studies by Inria Fun. Smart bins are connected together using ambient networks taking advantage of the city streets topology: this allow the balanced use of short range and low power communication interface between the nodes and cellular communication interface, prolonging the life of the network. A thesis on this topic was defended in November 2013. A prototype was implemented and integrated as a demonstrator Etineo, a company specialized in M2M communications.

7.1.2. Pervasive_RFID

- Partner: IETR
- Starting: July 2013; ending: July 2016

Pervasive_RFID is a joint effort (within the CominLabs initiative, see http://www.cominlabs.ueb.eu/) started in July 2013 with IETR (institut d'électronique et de télécommunications de Rennes) to study and design innovative RFID reading protocols in the context of pervasive computing applications. Some limitations of existing RFID technology become challenging: unlike standard RFID application scenarios, pervasive computing often involves uncontrolled environment for RFID, where tags and reader have to operate in much more difficult situations that those usually encountered or expected for classical RFID systems.

RFID technology is to avoid missing tags when reading multiple objects, as reading reliability is affected by various effects such shadowing or wave power absorption by some materials. The usual applications of RFID operate in a controlled environment in order to reduce the risk of missing tags while scanning objects.

In pervasive computing applications, a controlled reading environment is extremely difficult to achieve, as one of the principle is to enhance existing processes "in situ", unlike the controlled conditions that can be found in industrial processes. Consider for example a logistic application, where RFID tags could be used on items inside a package in order to check for its integrity along the shipping process. Tags would likely be placed randomly on items inside the package, and reading conditions would be variable depending on where the package is checked.
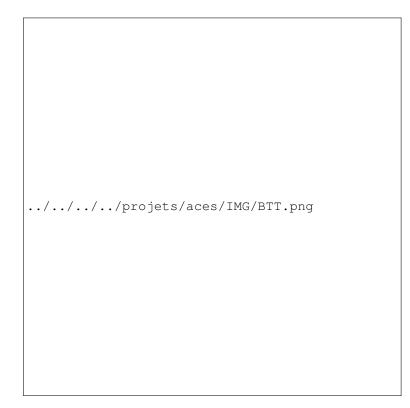
```
../../../../projets/aces/IMG/BTT.png
```

Figure 4. BinThatThink general architecture

RFID operation in uncontrolled environments is challenging because RFID performance is affected by multiple parameters, in particular:

- Objects materials (on which tags are attached to),
- Materials in the surrounding environment,
- RFID frequency spectrum,
- Antenna nature and placement with respect to the tags.

In controlled environment, the difficulty to read tags can be limited by using the appropriate parameters to maximize the RFID performance for the application. But in many cases, it is needed to read large number of objects of various nature, arranged randomly in a given area or container. Most pervasive computing applications fall in this context.

At the software level, RFID inventory reliability issue is usually addressed by anti-collisions mechanisms and redundancy mechanisms. Anti-collisions protocols limit the risk of data corruption when multiples tags have to reply to an inventory request. Redundancy is often implemented in RFID readers by aggregating the results of multiple inventory requests over a time frame, to give the tags multiple opportunities to reply. While useful, these strategies cannot ensure that a given inventory is valid or not (in other words, one or more tags may be missing without being noticed). We propose to address this issue with an original approach based on integrity checking, developed by ACES.

In situations where we have to read large collection of objects of various types, the performance is difficult to predict but may still be adequate for a given application. For example, some application can tolerate missing some tags, provided that miss read probability could be characterized. In some cases, read reliability could be improved using mechanical approaches, such as introducing movements in objects or antenna to introduce radio diversity during read. Finally, distributed data structure can be used over a set of tags to be used to mitigate the impact of mis-read (by using data redundancy) and to help the reading protocol by integrating hints about the tag set collection being read.

Our objective is to study extensively by experimentation the behavior of existing RFID solutions in the context of uncontrolled environment (meaning, random placement of tags on objects mixing various materials) in order to characterize their real-world performance regarding the parameters of such as tags numbers, density, frequencies, reader antenna design, dynamicity of objects (movements), etc. From these experimentations, we would like to identify the conditions that are favorable to acceptable performance, and the way where there are hopes of improvement with specific design for these difficult environments. These results should also allow improving the performance : high level integrity checks can guide low level operations by determining whether inventories are complete or not. This cross layer strategy should enable faster are more efficient inventory protocols, as we have shown in [3] where some first results of this approach are presented.

The first step in the project is the implementation of an experiment test bed in order to support the experiment campaign. This task involves a significant engineering effort, which is ongoing. The following figures shows the elements of the testbed being built, featuring multi-axis mobile RFID antenna that we will driven by the high level protocols to use radio diversity, and a target container which will support custom designed arrangement of tags that are challenging to read by standard RFID configurations.
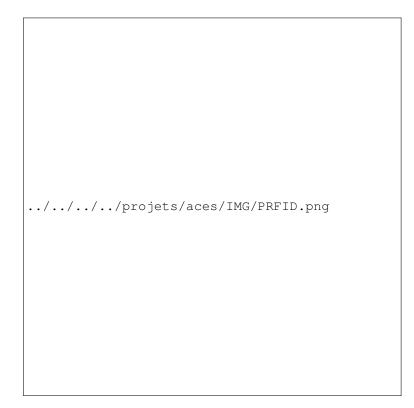
../../../../projets/aces/IMG/PRFID.png

Figure 5. Overview of the Pervasive RFID testbed

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

8. Partnerships and Cooperations

8.1. International Initiatives

8.1.1. Participation In International Programs

8.1.1.1. Imhotep (Egypt)

>Program: PHC
>
>Title: Code obfuscation through JIT compilation
>
>Inria principal investigator: Erven ROHOU
>
>International Partner (Institution - Laboratory - Researcher):
>
>>Egypt-Japan University for Science and Technology (Egypt)
>
>Duration: Jan 2013 - Dec 2013
>
>This project leverages JIT compilation to make software tamper-proof. The idea is to constantly generate different versions of an application, even while it runs, to make reverse engineering much more complex. A strong random number generator guarantees that generated code is not reproducible – though the semantics is the same. In the course of the project, we also studied new forms of On-Stack-Replacement that let us recompile code even from the middle of a function. Finally, we studied how threads can be exploited to generate new forms of obfuscation, leveraging the fact that parallelism is error-prone, and difficult to debug and reverse-engineer.

8.1.2. Informal International Partners

The ALF team has informal collaborations with several international teams: Carnegie Mellon (Pr Mutlu), Georgia Tech (Pr Qureshi), University of Wisconsin (Pr Wood), University of Cyprus (Pr Sazeides), University of Ghent (Dr Eyerman), XLNS Research (Dr Arnold), UFMG Brazil (Pr Pereira), Barcelona Supercomputing center (Pr Cazorla and Pr Abella),

8.2. National Initiatives

8.2.1. Inria Project Lab: Multicore

Participants: Erven Rohou, Alain Ketterlin, Nabil Hallou.

The Inria Project Lab (formerly *Action d'Envergure*) started in 2013. It is entitled "Large scale multicore virtualization for performance scaling and portability". Partner project-teams include: ALF, ALGORILLE, CAMUS, REGAL, RUNTIME, as well as DALI. This project aims to build collaborative virtualization mechanisms that achieve essential tasks related to parallel execution and data management. We want to unify the analysis and transformation processes of programs and accompanying data into one unique virtual machine.

8.2.2. ADT IPBS 2013-2015

Participants: Sylvain Collange, Erven Rohou, André Seznec, Thibault Person.

As multi-core CPUs and parallel accelerators become pervasive, all execution platforms are now parallel. Research on architecture, compilers and systems now focuses on parallel platforms. New contributions need to be validated against parallel applications that are expected to be representative of current or future workloads. The research community relies today on a few benchmarks sets (SPLASH, PARSEC, ..) Existing parallel benchmarks are scarce, and some of them have issues such as aging workloads or non-representative input sets. The IPBS initiative aims at leveraging the diversity of parallel applications developed within Inria to provide a set of benchmarks, named the Inria Parallel Benchmark Suite, to the research community.

8.2.3. ADT Padrone 2012–2014

Participants: Erven Rohou, Alain Ketterlin, Emmanuel Riou.

Computer science is driven by two major trends: on the one hand, the lifetime of applications is much larger than the lifetime of the hardware for which they are initially designed; on the other hand the diversity of computing hardware keeps increasing. The net result is that many applications are not optimized for their current executing environment. The objective of Padrone is to design and develop a platform for reoptimization of binary executables at run-time. There are many advantages: actual hardware is known, the whole application is visible (including libraries), profiling can be collected, and source code is not necessary (interesting in the case of proprietary applications).

8.2.4. ANR W-SEPT

Participants: Hanbing Li, Isabelle Puaut, Erven Rohou.

Critical embedded systems are generally composed of repetitive tasks that must meet drastic timing constraints, such as termination deadlines. Providing an upper bound of the worst-case execution time (WCET) of such tasks at design time is thus necessary to prove the correctness of the system. Static WCET estimation methods, although safe, may produce largely over-estimated values. The objective of the project is to produce tighter WCET estimates by discovering and transforming flow information at all levels of the software design process, from high level-design models (e.g. Scade, Simulink) down to binary code. The ANR W-SEPT project partners are Verimag Grenoble, IRIT Toulouse, Inria Rennes. A case study is provided by Continental Toulouse.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. DAL: ERC AdG 2010- 267175, 04-2011/03-2016

> Type: IDEAS
>
> Instrument: ERC Advanced Grant
>
> Duration: April 2011 - March 2016
>
> Coordinator: André Seznec
>
> Inria contact: André Seznec
>
> Abstract: In the DAL, Defying Amdahl's Law project, we envision that, around 2020, the processor chips will feature a few complex cores and many (may be 1000s) simpler, more silicon and power effective cores. In the DAL research project, we will explore the microarchitecture techniques that will be needed to enable high performance on such heterogeneous processor chips. Very high performance will be required on both sequential sections —legacy sequential codes, sequential sections of parallel applications— and critical threads on parallel applications —e.g. the main thread controlling the application. Our research will focus on enhancing single process performance. On the microarchitecture side, we will explore both a radically new approach, the sequential accelerator, and more conventional processor architectures. We will also study how to exploit heterogeneous multicore architectures to enhance sequential thread performance.
> For more information, see http://www.irisa.fr/alf/index.php?option=com_content&view=article&id=55&Itemid=3&lang=e

8.3.2. Collaborations in European Programs, except FP7

8.3.2.1. HiPEAC3 NoE

Participants: François Bodin, Pierre Michaud, Erven Rohou, André Seznec.

F. Bodin, P. Michaud, A. Seznec and E. Rohou are members of the European Network of Excellence HiPEAC3. HiPEAC3 addresses the design and implementation of high-performance commodity computing devices in the 10+ year horizon, covering both the processor design, the optimizing compiler infrastructure, and the evaluation of upcoming applications made possible by the increased computing power of future devices.

8.3.2.2. COST Action TACLe - Timing Analysis on Code-Level (http://www.tacle.eu) 10-2012/09-2015
Participants: Damien Hardy, Isabelle Puaut.

Embedded systems increasingly permeate our daily lives. Many of those systems are business- or safety-critical, with strict timing requirements. Code-level timing analysis (used to analyze software running on some given hardware w.r.t. its timing properties) is an indispensable technique for ascertaining whether or not these requirements are met. However, recent developments in hardware, especially multi-core processors, and in software organization render analysis increasingly more difficult, thus challenging the evolution of timing analysis techniques.

New principles for building "timing-composable" embedded systems are needed in order to make timing analysis tractable in the future. This requires improved contacts within the timing analysis community, as well as with related communities dealing with other forms of analysis such as model-checking and type-inference, and with computer architectures and compilers. The goal of this COST Action is to gather these forces in order to develop industrial-strength code-level timing analysis techniques for future-generation embedded systems, through several working groups:

- WG1 Timing models for multi-cores and timing composability
- WG2 Tooling aspects
- WG3 Early-stage timing analysis
- WG4 Resources other than time

8.4. International Research Visitors

8.4.1. *Visits of International Scientists*

- Pr Ahmed El-Mahdy, from the Egyptian-Japanese University of Science and Technology visited the ALF project for 1 week in October 2013.
- Pr Onur Mutlu, from Carnegie Mellon visited the ALF project for 3 weeks June-July 2013.

ASAP Project-Team

8. Partnerships and Cooperations

8.1. National initiatives

8.1.1. LABEX CominLabs

Participants: Anne-Marie Kermarrec, Davide Frey, Michel Raynal, François Taïani.

ASAP participates in the CominLabs initiative sponsored by the "Laboratoires d'Excellence" program. The initiative federates the best teams from Bretagne and Nantes regions in the broad area of telecommunications, from electronic devices to wide area distributed applications "over the top." These include, among the others, the Inria teams: ACES, ALF, ASAP, CELTIQUE, CIDRE, DISTRIBCOM, MYRIADS, TEMICS, TEXMEX, and Visages. The scope of CominLabs covers research, education, and innovation. While being hosted by academic institutions, CominLabs builds on a strong industrial ecosystem made of large companies and competitive SMEs. In this context, ASAP received funding for DeSeNt (a collaborative project with the Université de Nantes / LINA).

8.1.2. ANR ARPÈGE project Streams

Participants: Marin Bertier, Michel Raynal.

The Streams project started in November 2010. Beside the ASAP group, it includes teams from Inria Nancy and PARIS. Its aim it to design a real-time collaborative platform based on a peer-to-peer network. For this it is necessary to design a support architecture that offers guarantees on the propagation, security and consistency of the operations and the updates proposed by the different collaborating sites.

8.1.3. ANR project SocioPlug

Participants: Anne-Marie Kermarrec, Davide Frey, Michel Raynal, François Taïani.

SocioPlug is a collaborative ANR project involving Inria (ASAP team), the université de Nantes, and LIRIS (INSA Lyon and Universite Claude Bernard Lyon). The project emerges from the observation that the features offered by the Web 2.0 or by social media do not come for free. Rather they bring the implicit cost of privacy. Users are more of less consciously selling personal data for services. SocioPlug aims to provide an alternative for this model by proposing a novel architecture for large-scale, user centric applications. Instead of concentrating information of cloud platforms owned by a few economic players, we envision services made possible by cheap low-end plug computers available in every home or workplace. This will make it possible to provide a high amount of transparency to users, who will be able to decide their own optimal balance between data sharing and privacy.

8.1.4. DeSceNt CominLabs

Participants: Resmi Ariyattu Chandrasekharannair, Davide Frey, Michel Raynal, François Taïani.

The DeSceNt project aims to ease the writing of distributed programs on a federation of plug computers. Plug computers are a new generation of low-cost computers, such as Raspberry pi (25$), VIA- APC (49$), and ZERO Devices Z802 (75$), which offer a cheap and readily available infrastructure to deploy domestic on-line software. Plug computers open the opportunity for everyone to create cheap nano-clusters of domestic servers, host data and services and federate these resources with their friends, colleagues, and families based on social links. More particularly we will seek in this project to develop novel decentralized protocols than can encapsulate the notion of privacy-preserving federation in plug-based infrastructures. The vision is to use these protocols to provide a programming toolkit that can support the convergent data types being developed by our partner GDD (Grande Données Distribuées) at Université de Nantes.

8.1.5. ANR Blanc project Displexity

Participants: George Giakkoupis, Anne-Marie Kermarrec, Michel Raynal.

The Displexity project started in October 2011. The aim of this ANR project that also involves researchers from Paris and Bordeaux is to establish the scientific foundations for building up a consistent theory of computability and complexity for distributed computing. One difficulty to be faced by DISPLEXITY is to reconcile two non necessarily disjoint sub-communities, one focusing on the impact of temporal issues, while the other focusing on the impact of spatial issues on distributed algorithms.

8.2. European initiatives

8.2.1. FP7 projects

8.2.1.1. ALLYOURS ERC Proof of Concept

Title: AllYours: A distributed privacy-aware instant item recommender

Type: IDEAS

Instrument: ERC Proof of Concept Grant (Starting)

Duration: January 2013 - December 2013.

Coordinator: Inria (France)

See also: http://www.gossple.fr

Abstract: The goal of this PoC proposal is to boost the creation of a start-up (AllYours/MEDIEGO) targeting both Internet users as well as small to medium companies (SME) offering full-fledged personalization in notification systems. AllYours is a direct outcome from the GOSSPLE ERC Starting Grant, and more specifically from one of the activities conducted within the project, that today involves most of the team and forces. In the GOSSPLE ERC SG project, we have invented the concept of implicit social network, built and maintained in a fully decentralized manner so that each user is in charge of her own personalized data, addressing both the privacy concern that users may have with respect to Big Brother-like companies, and scalability as the resources present at the edges of the Internet can then be fully leveraged. The GOSSPLE social network has been the basis of several Web 2.0 applications in order to personalize Web functionalities within the project, such as search, recommendation, query expansion, top-k queries, etc. More specifically, we have been applying the GOSSPLE social network to personalized notification, defining on top of it a novel dissemination protocol. This is P2P-AllYours currently under development. Our MEDIEGO software is now applied to centralized systems for recommendations.

8.2.1.2. TOWARD THE ALLYOURS START-UP

Title: TOWARD THE ALLYOURS START-UP: Focus on the mobile version

Type: EIT-ICT Labs

Instrument: ACLD Computing in the Cloud

Duration: January 2013 - December 2013.

Coordinator: Inria (France)

Partners: Trento Rise, BDP EIT-ICT

See also: http://www.gossple.fr

Abstract: The goal of the Activity proposal is to turn the inventions from the ERC Starting Grant Project GOSSPLE to innovation by setting up a start-up (AllYours) targeting both Internet users as well as small to medium companies (SME) offering full-fledged personalization in notification systems. This proposal focuses on the mobile versions of AllYours software. While the wired setting is a goal of the foreseen startup, this proposal will focus on the mobile versions of E-AllYours and P2P AllYours that will be experimented on the live platform provided by the TrentoRise partners.

8.2.1.3. ERC SG Gossple

Title: GOSSPLE

Type: IDEAS

Instrument: ERC Starting Grant

Duration: September 2008 - August 2013

Coordinator: Inria (France)

See also: http://www.gossple.fr

Abstract: Anne-Marie Kermarrec is the principal investigator of the GOSSPLE ERC starting Grant (Sept. 2008 - Sept. 2013). GOSSPLE aims at providing a radically new approach to navigating the digital information universe. This project has been granted a 1.250.000 euros budget for 5 years.

GOSSPLE aims at radically changing the navigation on the Internet by placing users affinities and preferences at the heart of the search process. Complementing traditional search engines, GOSSPLE will turn search requests into live data to seek the information where it ultimately is: at the user. GOSSPLE precisely aims at providing a fully decentralized system, self-organizing, able to discover, capture and leverage the affinities between users and data.

8.2.2. Collaborations in European programs, except FP7

8.2.2.1. Transform Marie Curie Initial Training Network (ITN)
Participants: Tyler Crain, Eleni Kanellou, Anne-Marie Kermarrec, Michel Raynal.

Program: Marie Curie Initial Training Network

Project acronym: Transform

Project title: Theoretical Foundations of Transactional Memory

Duration: May 2010 - October 2013

Grant agreement no.: 238639

Date of approval of Annex I by Commission: May 26, 2009

Coordinators: Michel Raynal - Panagiota Fatourou

Other partners: Foundation for Research and Technology Hellas ICS FORTH Greece, University of Rennes I UR1 France, Ecole Polytechnique Federale de Lausanne EPFL Switzerland, Technische Universitaet Berlin TUB Germany, and Israel Institute of Technology Technion.

Abstract: Transform is a Marie Curie Initial Training Networks European project devoted to the Theoretical Foundations of Transactional Memory (Major chip manufacturers have shifted their focus from trying to speed up individual processors into putting several processors on the same chip. They are now talking about potentially doubling efficiency on a 2x core, quadrupling on a 4x core and so forth. Yet multi-core is useless without concurrent programming. The constructors are now calling for a new software revolution: the concurrency revolution. This might look at first glance surprising for concurrency is almost as old as computing and tons of concurrent programming models and languages were invented. In fact, what the revolution is about is way more than concurrency alone: it is about concurrency for the masses. The current parallel programming approach of employing locks is widely considered to be too difficult for any but a few experts. Therefore, a new paradigm of concurrent programming is needed to take advantage of the new regime of multicore computers. Transactional Memory (TM) is a new programming paradigm which is considered by most researchers as the future of parallel programming. Not surprisingly, a lot of work is being devoted to the implementation of TM systems, in hardware or solely in software. What might be surprising is the little effort devoted so far to devising a sound theoretical framework to reason about the TM abstraction. To understand properly TM systems, as well as be able to assess them and improve them, a rigorous theoretical study of the approach, its challenges and its benefits is badly needed. This is the challenging research goal undertaken by this MC-ITN. Our goal

through this project is to gather leading researchers in the field of concurrent computing over Europe, and combine our efforts in order to define what might become the modern theory of concurrent computing. We aim at training a set of Early Stage Researchers (ESRs) in this direction and hope that, in turn, these ESRs will help Europe become a leader in concurrent computing. Its keywords are Transactional Memory, Parallelization Mechanisms, Parallel Programming Abstractions, Theory, Algorithms, Technological Sciences

8.2.3. Collaborations with major European organizations

Ecole Polytechnique Federale de Lausanne EPFL Switzerland; collaboration on the ERC SG GOSSPLE and Transform, and the Google Focused Award Web-Alter-Egos.

Foundation for Research and Technology Hellas ICS FORTH Greece; collaboration on Transform

8.3. International initiatives

8.3.1. Inria associate teams

8.3.1.1. RADCON

Title: Randomized Algorithms for Distributed Computing and Networks

Inria principal investigator: George Giakkoupis

International Partner:

University of Calgary (Canada) - Department of Computer Science - Philipp Woelfel

Duration: 2013 - 2015

See also: http://www.irisa.fr/asap/radcon

Over recent years, computing systems have seen a massive increase in parallelism and interconnectivity. Peer-to-peer systems, ad-hoc networks, sensor networks, or the "cloud" are based on highly connected and volatile networks. Individual nodes such as cell phones, desktop computers or high performance computing systems rely on parallel processing power achieved through multiple processing units. To exploit the power of massive networks or multiple processors, algorithms must cope with the scale and asynchrony of these systems, and their inherent instability, e.g., due to node, link, or processor failures. In this research project we explore randomized algorithms for large-scale networks of distributed systems, and for shared memory multi-processor systems. For large-scale networks, decentralized gossip protocols have emerged as a standard approach to achieving fault-tolerant communication between nodes with simple and scalable algorithms. We will devise new gossip protocols for various complex distributed tasks, and we will explore the power and limits of gossip protocols in various settings. For shared memory systems, randomized algorithms have proved extremely useful to deal with asynchrony and failures. Sometimes probabilistic algorithms provide the only solution to a problem; sometimes they are more efficient; sometimes they are simply easier to implement. We will devise efficient algorithms for some of the fundamental problems of shared memory computing, such as mutual exclusion, renaming, and consensus.

8.3.2. Inria international partners

University of Calgary

Universidad Nacional Autonoma de Mexico

University of Glasgow

8.3.3. Participation in international programs

8.3.3.1. Demdyn: Inria/CNPq Collaboration
Participants: Marin Bertier, Michel Raynal.

The aim of this project is to exploit dependable aspects of dynamic distributed systems such as VANETs, WiMax, Airborn Networks, DoD Global Information Grid, P2P, etc. Applications that run on these kind of networks have a common point: they are extremely dynamic both in terms of the nodes that take part of them and available resources at a given time. Such dynamics results in instability and uncertainty of the environment which provide great challenges for the implementation of dependable mechanisms that ensure the correct work of the system. This requires applications to be adaptive, for instance, to less network bandwidth or degraded Quality-of-Service (QoS). Ideally, in these highly dynamic scenarios, adaptiveness characteristics of applications should be self-managing or autonomic. Therefore, being able to detect the occurrence of partitions and automatically adapting the applications for such scenarios is an important dependable requirement for such new dynamic environments.

8.4. International research visitors

8.4.1. Visits of international scientists

Zarah Aghazadeh, University of Calgary, from 6 to 27 July 2013

Laurent Fournier, Cup Foundation Toulouse, 13 November 2013

Roy Friedman, Technion University Tel Aviv, 20 December 2013

Christian Grothoff, TU Munich, 26 November 2013

Jean-Loup Guillaume, Lip6 Paris, 12 March 2013

Gilles Tredan, Laass Toulouse, from 2 to 10 September 2013

Philipp Woelfel, University of Calgary, from 6 to 14 July 2013

8.4.2. Internships

Hoël Kervadec; 1 July 2013 to 6 September 2013. "Construction décentralisée de topologies informatiques réparties à mémoire de forme." Supervised by François Taïani.

Nabil Kmihi; 16 May 2013 to 8 November 2013. "Offline social networks." Supervised by Anne-Marie Kermarrec.

Olivier Ruas; 1 February 2013 to 30 June 2013. "Degree-based routing in small world networks." Supervised by George Giakkoupis and Anne-Marie Kermarrec.

Sylvain Fabre; 1 July 2013 to 31 August 2013. "Elaboration d'un overlay qui prend en compte la localisation des noeuds." Supervised by Marin Bertier.

Vincent L'Honore; 10 July 2013 to 2 August 2013. "The development of the mobile-based Android application of MEDIEGO Dashboard." Supervised by Antoine Boutet.

Yahya Benkaouz; 1 December 2013 to 28 February 2014. "La conception et la mise en œuvre d'un réseau social décentralisé respectant la vie privée des utilisateurs et son intégration dans le système Gossple." Supervised by Anne-Marie Kermarrec.

8.4.3. Visits to international teams

George Giakkoupis visited University of Calgary, Canada, twice, from 15 April to 6 May and from 23 November to 14 December. He also visited MPI, Saarbrücken, Germany, from 3 to 9 August.

Anne-Marie Kermarrec was a part-time visiting professor at EPFL, Lausanne.

Anne-Marie Kermarrec visited University of Sydney and NICTA, Australia, Jan 2014.

ASCOLA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. CominLabs laboratory of excellence

8.1.1.1. EPOC
Participants: Jean-Marc Menaud [coordinator], Thomas Ledoux.

The project EPOC (Energy Proportional and Opportunistic Computing system) is an (academic) Labex CominLabs project running for 4 years. Four other partners collaborate within the project that is coordinated by ASCOLA: Myriads team, ENIB, ENSTB and University of Nantes. In this project, partners aim at focusing on energy-aware task execution from the hardware to application's components in the context of a *mono-site* data center (all resources are in the same physical location) which is connected to the *regular electric Grid and to renewable energy sources* (such as windmills or solar cells). Three major challenges are addressed in this context: Optimize the energy consumption of distributed infrastructures and service compositions in the presence of ever more dynamic service applications and ever more stringent availability requirements for services; Design a clever cloud's resource management which takes advantage of renewable energy availability to perform opportunistic tasks, then exploring the trade-off between energy saving and performance aspects in large-scale distributed system; Investigate energy-aware optical ultra high-speed interconnection networks to exchange large volumes of data (VM memory and storage) over very short periods of time.

One of the strengths of the proposal is to provide a systematic approach, and use a single model for the system (from hard to soft) by mixing constraint programming and behavioral models to manage energy consumption in data centers.

8.1.1.2. SecCloud
Participants: Jacques Noyé [coordinator], Florent Marchand de Kerchove de Denterghem, Mario Südholt.

The high-level objective of the 3-year SecCloud (Secure Scripting for the Cloud) project is to enhance the security of devices on which web applications can be downloaded, i.e. to enhance client-side security in the context of the Cloud. In order to do so, the project relies on a language-based approach, focusing on three related issues:

- The definition of security policies for web architectures, especially on the client-side.
- Formally-proven analyses of web programming languages.
- Multi-level enforcement mechanisms for the security policies (based on static and dynamic analysis encompassing application-level and system-level software).

ASCOLA members are mainly interested in JavaScript as a programming language as well as the use of aspects as a seamless path from the definition of security policies and their composition to their implementation.

This year we have proposed new means for the modularization of JavaScript-based security mechanisms and policies (see 6.1).

8.1.2. ANR

8.1.2.1. CESSA (ANR/ARPEGE)
Participants: Mario Südholt [coordinator], Diana Allam, Rémi Douence, Hervé Grall, Jean-Claude Royer.

The project CESSA (Compositional Evolution of Secure Services with Aspects) is an (industrial) ANR project running for 3 years months, with funding amounting to 290 KEUR for ASCOLA from Jan. 10 on. Three other partners collaborate within the project that is coordinated by ASCOLA: a security research team from Eurecom, Sophia-Antipolis, the Security and Trust team from SAP Labs, also located at Sophia-Antipolis, and IS2T, an innovative start-up company developing middleware technologies located at Nantes. The project deals with security in service-oriented architectures.

This year our group has contributed several scientific publications as part of the project. All partners have been involved in the publication of a unifying model for WD*/SOAP-based and RESTful web services. Furthermore, we have formally defined a type system that is safe in the presence of malicious attackers and insecure communication channels (see 6.1).

All information is available from the CESSA web site: http://cessa.gforge.inria.fr.

8.1.2.2. MyCloud (ANR/ARPEGE)

Participants: Thomas Ledoux [coordinator], Jean-Marc Menaud, Yousri Kouki, Frederico Alvares.

The MyCloud project is an ANR/ARPEGE project running for 42 months, starting in Nov. 2010. It was accepted in Jul. 2010 for funding amounting to 190 KEUR (ASCOLA only). MyCloud involves a consortium with three academic partners (Inria, LIP6, EMN) and one industrial partner (We Are Cloud).

Cloud Computing provides a convenient means of remote on-demand and pay-per-use access to computing resources. However, its ad-hoc management of quality-of-service (QoS) and SLA poses significant challenges to the performance, dependability and costs of online cloud services.

The objective of MyCloud (http://mycloud.inrialpes.fr) is to define and implement a novel cloud model: SLAaaS (SLA as a Service). The SLAaaS model enriches the general paradigm of Cloud Computing and enables systematic and transparent integration of SLA to the cloud [45], [50]. From the cloud provider's point of view, MyCloud proposes autonomic SLA management to handle performance, availability, energy and cost issues in the cloud. From the cloud customer's point of view, MyCloud provides SLA governance allowing cloud customers to be part of the loop and to be automatically notified about the state of the cloud, such as SLA violation and cloud energy consumption.

This year, the ASCOLA project-team has proposed: (i) SCAling, an auto-scaling approach driven by SLA and based on a MAPE-K control loop framework [39]; (ii) RightCapacity, a cross-layer (application-resource) Cloud elasticity approach based on queueing network model, taking into account the SLA concept and the Cloud economic model [17].

8.1.2.3. SONGS (ANR/INFRA)

Participants: Adrien Lèbre [coordinator], Flavien Quesnel, Jonathan Pastor, Takahiro Hirofuchi.

The SONGS project (Simulation of Next Generation Systems) is an ANR/INFRA project running for 48 months (starting in January 2012 with an allocated budget of 1.8MEuro, 95KEuro for ASCOLA).

The consortium is composed of 11 academic partners from Nancy (AlGorille, coordinator), Grenoble (MESCAL), Villeurbanne (IN2P3 Computing Center, GRAAL/Avalon - LIP), Bordeaux (CEPAGE, HiePACS, RUNTIME), Strasbourg (ICPS - LSIIT), Nantes (ASCOLA), Nice (MASCOTTE, MODALIS).

The goal of the SONGS project (http://infra-songs.gforge.inria.fr) is to extend the applicability of the SimGrid simulation framework from Grids and Peer-to-Peer systems to Clouds and High Performance Computation systems. Between January and December 2013, we have hosted Takahiro Hirofuchi, Researcher at AIST (Japan). During his stay, we have extended the Simgrid toolkit with VM abtractions [35]. In addition to elementary functionalities such as VM start/stop, we have delivered the first accurate model of live migration operations within IaaS systems [36].

8.1.3. FSN

8.1.3.1. OpenCloudware (FSN)

Participants: Jean-Marc Menaud [coordinator], Thomas Ledoux, Yousri Kouki.

The OpenCloudware project is coordinated by France Telecom, funded by the French Fonds National pour la Société Numérique (FSN, call Cloud n°1) and endorsed by competitiveness clusters Minalogic, Systematic and SCS. OpenCloudware is developed by a consortium of 18 partners bringing together industry and academic leaders, innovative technology start-ups and open source community expertise. Duration: 36 months - 2012–2014.

The OpenCloudware project aims at building an open software engineering platform, for the collaborative development of distributed applications to be deployed on multiple Cloud infrastructures. It will be available through a self-service portal. We target virtualized multi-tier applications such as JavaEE - OSGi. The results of OpenCloudware will contain a set of software components to manage the lifecycle of such applications, from modelling(Think), developing and building images (Build), to a multi-IaaS compliant PaaS platform (Run).

The ASCOLA project-team is mainly involved in the sub-projects "Think" (SLA model accross Cloud layers) and "Run" (virtual machine manager for datacenters and placement constraints). In 2013, the team has developed btrCloudStack, a private cloud based on the OpenSource CloudStack and integrating the work on placement rules and energy optimization.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. A4Cloud (IP)
Participants: Mario Südholt [coordinator], Ronan-Alexandre Cherrueau, Rémi Douence, Hervé Grall, Jean-Claude Royer, Mohamed Sellami.

The A4Cloud project (Accountability for the Cloud) is an integrated EU project, coordinated by HP, UK, on the topic of accountability, that is, the responsible stewardship of private data, in the Cloud. This 42-months project started in Oct. 2012 and Ascola's funding amounts to 600 KEuro.

The project involves 13 partners: in addition to HP, two enterprises (SAP AG, Germany; ATC, Greece), a non-governmental organisation (the Cloud Security Alliance, CSA) and 9 universities and research organisations (EMNantes and Eurecom, France; HFU. Furtwangen, Germany; Karlstadt U., Sweden; U. Malaga, Spain; Queen Mary U., U.K.; U. Stavanger and Sintef, Norway; Tilburg U., The Netherlands).

A4Cloud focuses on accountability properties for the cloud and other future internet services as the most critical prerequisite for effective governance and control of corporate and private data processed by cloud-based IT services. The research being conducted in the project will increase trust in cloud computing by devising methods and tools, through which cloud stakeholders can be made accountable for the privacy and confidentiality of information held in the cloud. These methods and tools will combine risk analysis, policy enforcement, monitoring and compliance auditing. They will contribute to the governance of cloud activities, providing transparency and assisting legal, regulatory and socio-economic policy enforcement. For further information, see http://www.a4cloud.eu.

ASCOLA is mainly involved in the sub-projects on the enforcement of accountability and security policies, as well as tool validation efforts.

8.2.2. Collaborations in European Programs, except FP7

8.2.2.1. SCALUS (MC ITN)
Participants: Adrien Lèbre [coordinator], Mario Südholt, Gustavo Bervian Brand.

The vision of the Scalus (SCALing by means of Ubiquitous Storage) (MC international training network) was to deliver the foundation for ubiquitous storage systems, which can be scaled with respect to multiple characteristics (capacity, performance, distance, security, ...). Providing ubiquitous storage will become a major demand for future IT systems and leadership in this area can have significant impact on European competitiveness in IT technology. To get this leadership, it is necessary to invest into storage education and research and to bridge the current gap between local storage, cluster storage, grid storage, and cloud storage. During the four last years, the consortium proceeded into this direction by building the first interdisciplinary teaching and research network on storage issues. It consisted of top European institutes and companies in storage and cluster technology, building a demanding but rewarding interdisciplinary environment for young researchers.

The network involved the following partners: University of Paderborn (Germany, coordinator), Barcelona Super Computing (Spain), University of Durham (England), University of Frankfurt (Germany), ICS-FORTH (Greece), Universidad Polytecnica de Madrid (Spain), EMN/ARMINES (France), Inria Rennes Bretagne Atlantique (France), XLAB (Slovenia), University of Hamburg (Germany), Fujistu Technology Systems (Germany).

The overall funding of the project by the European Union was closed to 3,3 MEUR. ASCOLA's share amounts to 200 KEUR. The project ended in October.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. REAL

Title: Reasoning about Effects in Aspect Languages

Inria principal investigator: Jacques Noyé

International Partner (Institution - Laboratory - Researcher):

University of Chile (Chile) - PLEIAD - Éric Tanter

Duration: 2013 - 2015

See also: http://real.gforge.inria.fr

The scientific goals of this collaboration are twofold. On the one hand, we plan to develop a theory to reason about aspect interference in general, i.e. covering both base/aspect and aspect/aspect composition and, more precisely, to reason about effects that can be used by aspects. This provides foundations for secure aspects. On the other hand, we plan to study how secure aspects can help construct security aspects, i.e. aspects ensuring security policies. Our case study is web applications built with web scripting languages such as JavaScript.

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

ASCOLA is closely cooperating with several other international partners:

- **AIST, Japan; Dr. Takahiro Hirofuchi.** This year we have started a cooperation on the simulation of Cloud infrastructures and new scheduling algorithms for virtual environments 6.3 . Dr. Takahiro Hirofuchi has visited the team in 2013 in the context of this collaboration.

- **Soft team, VU Brussel, Belgium; Prof. Wolfgang De Meuter.** In the context of a joint PhD thesis that started in Dec. 2013, we are working on new means for the declarative definition and efficient implementation of event-based systems.

- **Software Technology Group, TU Darmstadt, Germany; Prof. Mira Mezini.** In the context of a joint PhD thesis we are working on a common model for object-oriented programming, event-based programming and aspect-oriented programming, see 6.2 .

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Éric Tanter (University of Chile), 2-12 July 2013, in the context of the Associate Team REAL.
- Takahiro Hirofuchi (AIST, Japan), 1 Jan-31 Dec 2013, in the context and with the financial support of the ANR SONGS project.

8.4.1.1. Internships

Ismael FIGUEROA (from Apr 2013 until Jun 2013)

Compositional Reasoning About Aspect Interference (this leads to a publication in Modularity'14 [33]).

Institution: University of Chile (Chile)

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

7. Partnerships and Cooperations

7.1. National initiatives

7.1.1. PDMP Inférence, Évolution, Contrôle et Ergodicité (PIECE) — ANR Jeunes Chercheuses et Jeunes Chercheurs

Participant: Florent Malrieu.

January 2013 to December 2016.

Piecewise deterministic markov processes (PDMP) are non-diffusive stochastic processes which naturally appear in many areas of applications as communication networks, neuron activities, biological populations or reliability of complex systems. Their mathematical study has been intensively carried out in the past two decades but many challenging problems remain completely open. This project aims at federating a group of experts with different backgrounds (probability, statistics, analysis, partial derivative equations, modelling) in order to pool everyone's knowledge and create new tools to study PDMPs. The main lines of the project relate to estimation, simulation and asymptotic behaviors (long time, large populations, multi-scale problems) in the various contexts of application.

7.2. International initiatives

7.2.1. Inria international partners

Arnaud Guyader collaborates with the group of Nicolas Hengartner at Los Alamos National Laboratories, on the development of fast algorithms to simulate rare events, and on iterative bias reduction techniques in nonparametric estimation. This collaboration has a long record of bilateral visits, and a succesful co–direction of a PhD thesis.

7.3. International research visitors

7.3.1. Visits to international teams

Arnaud Guyader has been invited by Nicolas Hengartner to visit LANL (Los Alamos National Laboratories) in July 2013.

François Le Gland has been invited by Arunabha Bagchi to visit the department of applied mathematics of the University of Twente in Enschede, in October 2013.

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

Program: Pole Images et Reseaux - Appel Projets PME 2011

Project title: StreamMaster

Duration: 2012 - 2014

Coordinator: Data Syscom

Other partners: Research and University (University of Nantes, Ecole de Design Nantes Atlantique, ESC Rennes) and Vendors and service providers (IMINFO)

Abstract: The purpose of the StreamMaster project is creating a universal software solution for the smart management of document streams, providing an added value over all the chain. StreamMaster will provide: an hybrid (local and remote) technological platform to allow user access, the possibility of connection to every information system and every input and output stream, the management of all the parameters of the document stream (cost, speed, delay, quality, environmental impact), security and reinforced document authentication mechanisms, non-falsifiable documents by means of invisible document tatooing, an innovative and multimodal HMI.

Program: Pays de la Loire regional funding. Call: Creation of new teams

Project title: AtlanMod New Team Creation

Duration: 2011 - 2014

Coordinator: AtlanMod

Other partners: None

Abstract: AtlanMod has been funded by the Pays de la Loire Regional Council new research teams program. This funding will mainly cover a PhD Student and two years of a postdoc to work on the quality of models research line.

8.2. National Initiatives

8.2.1. FUI

Program: FUI - AAP 15

Project acronym: MoNoGe

Project title: Atelier de Modélisation de Nouvelle Génération

Duration: 2013 - 2016

Coordinator: Softeam

Other partners: Industry (DCNS), Research and University (ARMINES AtlanMod, LIP6) and Vendors and service providers (Softeam, Soft-Maint, Mia-Software)

Abstract: There is currently in companies a wide diversity of models and modeling tools according to the application domains, services or contexts which are concerned. This implies different problems forbidding their plain exploitation: traceability, global coherence, continuity between works, knowledge management, etc. All are largely penalized by this situation that harms the mastering of the complexity of the related systems and software. The MoNoGe project has for objective to bring innovative solutions allowing to ensure the agility of the models and modeling tools. The term agility is here referring to the properties of interoperability, extensibility and evolution of models. The dynamic extension mechanism to be developed in MoNoGe, potentially inspiring from the OMG MEF standard currently under definition, is intended to preserve the original metamodel which can be conserved, partially hidden or extended. Thus, the legacy data and models can stay operational with the extended metamodel. The user does not have to deal with heavy migration or conversion operations, and can this way focus on its modeling activities while continuously exploiting past models.

Program: ANR - ARPEGE program

Project acronym: Galaxy

Project title: Galaxy

Duration: 2010 - 2013

Coordinator: Airbus

Other partners: Industry (Airbus), Research and University (Armines -AtlanMod-, IRIT, LIP6) and Vendors and service providers (AKKA, Softeam)

Abstract: GALAXY (http://galaxy.lip6.fr) proposes to deal with the model driven collaborative development of complex systems. Galaxy aims at defining an open and flexible architecture particularly designed to be scalable. One of the key points is related to the fragmentation and distributiveness of huge models, their synchronization and relationship with communication means classically used by development teams. The work is being driven by use cases provided by a company (Airbus), which describe scalability issues they face during systems developments. Our work in this project is composed of two main parts: 1) the conception of efficient mechanisms for multiple views of complex (large) models; 2) the definition of a solution for the automation of modeling tasks on large model repositories, like the execution of large amounts of transformations, the orchestration of their execution, and the effective browsing of repositories for finding specific models. In this context we have developed MoScript, a scripting language (and corresponding execution engine) to write batch processing modeling tasks.

Program: FUI - AAP 13

Project acronym: TEAP

Project title: TOGAF Entreprise Architecture Platform

Duration: 2012 - 2014

Coordinator: Obeo

Other partners: Industry (DCNS), Research and University (Inria AtlanMod) and Vendors and service providers (Obeo, Capgemini)

Abstract: The fast evolution of technologies (SOA, Cloud, mobile environments), the systems complexity and the growing need for agility require to be able to represent information systems as a whole. The high-level approach promoted by Enterprise Architecture (EA) is a key element in this context and intends to address all the systems dimensions: software components, associated physical resources, relationships with the companies requirements and business processes, implied actors/roles/structures, etc. The objective of the TEAP project is to specify and implement an EA platform based on the Open Group international standard named TOGAF and on the SmartEA technical solution. In addition to its base modeling capabilities, this platform will allow data federation from different existing sources (e.g. for reverse engineering purposes such as retro-cartography) as well as the definition of possible transformation chains (for governance and modernization). As part of this project, we are notably using in practice (and improving) some of our works such as Virtual EMF, ATL or some MoDisco components.

Program: FUI - AAP 13

Project acronym: ITM Factory

Project title: Information Technology Modernisation Factory

Duration: 04/2012 - 10/2014

Coordinator: Soft-Maint (Groupe SODIFRANCE)

Other partners: Mia-Software (Groupe SODIFRANCE), ACAPNOS, MMA and Inria AtlanMod.

Abstract: Application maintenance represents about 80 per cent of the computer market (at the French and global level). The challenge of software maintenance is to keep running applications with technologies that are no longer required to be maintained and with changing development teams and whose skills are not always validated on ancient languages. The main goal of the ITM Factory is to propose a software modernization framework, based on the ModDisco project and including: (i) an integrated workbench for software modernization engineers and (ii) a set of ready to use modernization cartirdges, i.e., a solution brick that meets a business challenge level, as opposed to a technical bricks that provides technical solutions that are integrated into a business solution.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. ARTIST

Type: COOPERATION

Defi: Cloud Computing, Internet of Services and Advanced Software engineering

Instrument: Integrated Project

Duration: October 2012 - September 2015

Coordinator: Clara Pezuela (ATOS Spain)

Partner: ATOS and TECNALIA (Spain), Inria AtlanMod (France), Fraunhofer (Germany), TU Wien and Sparks (Austria), ENGINEERING (Italy), Spikes (Belgium), ATC and ICCS (Greece)

Inria contact: Hugo Bruneliere

Abstract: Nowadays Cloud Computing is considered as the ideal environment for engineering, hosting and provisioning applications. A continuously increasing set of cloud-based solutions is available to application owners and developers to tailor their applications exploiting the advanced features of this paradigm for elasticity, high availability and performance. Even though these offerings provide many benefits to new applications, they often incorporate constrains to the modernization and migration of legacy applications by obliging the use of specific development technologies and explicit architectural design approaches. The modernization and adaptation of legacy applications to cloud environments is a great challenge for all involved stakeholders, not only from the technical perspective, but also in business level with the need to adapt the business processes and models of the modernized application that will be offered from now on, as a service. The purpose of the ARTIST project is to propose and develop a novel model-driven approach for the migration of legacy applications in modern cloud environments which covers all aspects and phases of the migration process, as well as an integrated framework that supports all migration process.

8.3.1.2. MONDO

Title: Scalable Modelling and Model Management on the Cloud

Type: COOPERATION (ICT)

Defi: Cloud Computing, Internet of Services and Advanced Software engineering

Instrument: Small or medium-scale focused research project (STREP)

Duration: November 2013 - May 2016

Coordinator: The Open Group - X/Open Company

Partners: The Open Group - X/Open Company (United Kingdom), University of York (United Kingdom), Universidad Autonoma de Madrid (Spain), Budapest University of Technology and Economics (Hungary), IKERLAN (Spain), MIA Software (France), Cassidian (Germany)

Inria contact: Massimo Tisi

Abstract: As Model Driven Engineering (MDE) is increasingly applied to larger and more complex systems, the current generation of modelling and model management technologies are being pushed to their limits in terms of capacity and efficiency, and as such, additional research is imperative in order to enable MDE to remain relevant with industrial practice and continue delivering its widely recognised productivity, quality, and maintainability benefits. The aim of MONDO is to tackle the increasingly important challenge of scalability in MDE in a comprehensive manner. Achieving scalability in modelling and MDE involves being able to construct large models and domain specific languages in a systematic manner, enabling teams of modellers to construct and refine large models in a collaborative manner, advancing the state-of-the-art in model querying and transformations tools so that they can cope with large models (of the scale of millions of model elements), and providing an infrastructure for efficient storage, indexing and retrieval of large models. To address these challenges, MONDO brings together partners with a long track record in performing internationally-leading research on software modelling and MDE, and delivering research results in the form of robust, widely-used and sustainable open-source software, with industrial partners active in the fields of reverse engineering and systems integration, and a global consortium including more than 400 organisations from all sectors of IT.

8.3.1.3. Automobile

Title: Automated Mobile App Development

Type: Research For SMEs

Duration: November 2013 - October 2015

Coordinator: WebRatio s.r.l.

Partners: WebRatio, Politecnico di Milano (ITaly), AtlanMod-Armines, Moon Submarine (UK), ForwardSoftware (Rumania).

Inria contact: Jordi Cabot

Abstract:The AutoMobile project aims at designing and bringing to the market innovative methodologies, software tools, and vertical applications for the cost-effective implementation of cross-platform, multi-device mobile applications, i.e. business applications that can be accessed by users on a variety of devices and operating systems, including PC, cellular / smart phones and tablets.

Cross-platform and multi-device design, implementation and deployment is a barrier for today's IT solution providers, especially SME providers, due to the high cost and technical complexity of targeting development to a wide spectrum of devices, which differ in format, interaction paradigm, and software architecture.

AutoMobile will exploit the modern paradigm of Model-Driven Engineering and code generation to dramatically simplify multi-device development, reducing substantially cost and development times, so as to increase the profit of SME solution providers and at the same time reduce the price and total cost of ownership for end-customers.

AutoMobile will rely on modeling languages such as IFML (Interaction Flow Modeling Languages) and on tools like WebRatio.

8.3.2. Collaborations in European Programs, except FP7

Program: CORE Multi-annual thematic research programme. Fonds National de la Recherche Luxembourg.

Project acronym: TOOM

Project title: Testing Orders of Magnitude

Duration: September 2013 - August 2015

Coordinator: SnT/University of Luxembourg

Other partners: the iTrust company, EBRC, Inria Rennes/University of Nantes and the UFPR (Brazil).

Abstract: Over the last decade, large-scale systems drew much attention due to scalability and resiliency features. Many popular large-scale data-oriented systems (i.e., BigData), including, Peer-to-peer (P2P) and MapReduce, reached millions of users and processed petabytes of data, such as: Hadoop, Skype, Bittorrent, and Gnutella. The main reason is due to a decentralized manner to remove potential performance bottlenecks and centralized points of failure. Recently, cloud computing is gathering all these BigData systems underneath its layers (e.g. Paas, Saas, Iaas) to free developers from large-scale issues, such as: deployment, distribution, resiliency, security, and performance. Several companies around the globe rely on cloud computing to build robust and reliable services for their business operations (e.g. eBay, Amazon, Skype) mainly to handle heavy load conditions (e.g. seasonal sales, Internet-scale malicious attacks). Testing robustness and reliability of cloud computing services is a hard activity, the state of the art shows that the existing testing techniques suffer to handle aspects, such as: the scale of the cloud, the dynamism of the nodes, and the amount of data and load. In general, these testing techniques rely on a combination of unit tests with some mocking approach that may hide the cloud aspects and may not be suited for large-scale testing. The TOOM project is planned to present a solution for testing robustness of cloud computing services built on top of P2P technology to address scalability and dynamism aspects. The main contributions lie on two main steps. The first one is to validate the overall resilience and reliability of cloud services. The second one is to reproduce large-scale stress loads, such as Distributed Denial of Service (DDoS) and peak loads, either gathered from the real load traces or synthetically generated. We plan to leverage data warehouse technology to house real load traces and use them during testing. To generate synthetic loads, we plan to use known load patterns or adapt them to new load trends. To assess the effectiveness of the TOOM outcomes, we will reproduce stress loads submitted by P2P technology across the cloud infrastructure on top of step-stress testing methodologies. In this manner, we can progressively increase the load in orders of magnitude up to a peak load. Then, we will measure the effectiveness either by code coverage whether the SUT is open-source, by the quality of service (QoS) of the SUT, or by the coverage of network and computing components used by the cloud computing services.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal International Partners

The three main research partners of the team are:

- Politecnico di Milano (Italy) - DB Group, specially with Marco Brambilla
- TU Wien (Austria) - BiG Group, specially Manuel Wimmer
- Politecnica de Catalunya (Spain) - GESSI Group, specially Xavier Franch

8.5. International Research Visitors

8.5.1. Visits of International Scientists

This year, the following visitors did a research stay with AtlanMod:

- Galina Besova (University of Paderborn, Germany), May-July
- Javier Criado (University of Almeria, Spain), October

8.5.1.1. Internships

Camilo Alvarez

Subject: Transformations from Legacy Models to the Cloud

Date: from Apr 2013 until Aug 2013

Institution: University of Los Andes (Colombia)

Matthieu Allon

Subject: Interoperability and traceability between modeling languages and standards

Date: from February 2013 until Aug 2013

Institution: University of Science and Technology of Nantes (France)

8.5.2. Visits to International Teams

No long term visits.

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

7. Partnerships and Cooperations

7.1. National Initiatives

The CAIRN team has currently some collaboration with the following laboratories: CEA List, CEA Leti, LEAT Nice, Lab-Sticc (Lorient, Brest), LIRMM (Montpellier, Perpignan), LIP6 Paris, IETR Rennes, Ireena Nantes; and with the following Inria project-teams: Aric, Compsys, Socrate.

The team participates in the activities of the following research organization of CNRS (GdR for in French *"Groupe de Recherche"*):

- GdR SOC-SIP (*System On Chip & System In Package*), working groups on reconfigurable architectures, embedded software for SoC, low power issues. E. Casseau is in charge of the architecture topic of the reconfigurable platform working group.

- GdR ISIS (*Information Signal ImageS*), working group on *Algorithms Architectures Adequation*.

- GdR ASR (*Architectures Systèmes et Réseaux*)

- GdR IM (*Informatique Mathématiques*), C2 working group on Codes and Cryptography and ARITH working group on Computer Arithmetic

7.1.1. ANR Blanc - PAVOIS (2012–2016)

Participants: Arnaud Tisserand, Emmanuel Casseau, Romuald Rocher, Philippe Quémerais, Jérémie Métairie, Nicolas Veyrat-Charvillon, Nicolas Estibals, Thomas Chabrier, Karim Bigou.

PAVOIS (in French: *Protections Arithmétiques Vis à vis des attaques physiques pour la cryptOgraphIe basée sur les courbeS elliptiques*) is a project on Arithmetic Protections Against Physical Attacks for Elliptic Curve based Cryptography. It involves IRISA-CAIRN (Lannion) and LIRMM (Perpignan and Montpellier). This project will provide novel implementations of curve based cryptographic algorithms on custom hardware platforms. A specific focus will be placed on trade-offs between efficiency and robustness against physical attacks. One of our goal is to theoretically study and practically measure the impact of various protection schemes on the performance (speed, silicon cost and power consumption). Theoretical aspects will include an investigation of how special number representations can be used to speed-up cryptographic algorithms, and protect cryptographic devices from physical attacks. On the practical side, we will design innovative cryptographic hardware architectures of a specific processor based on the theoretical advancements described above to implement curve based protocols. We will target efficient and secure implementations for both FPGA an ASIC circuits. For more details see http://pavois.irisa.fr.

7.1.2. ANR INFRA 2011 - FAON (2012-2015)

Participants: Raphaël Bardoux, Arnaud Carer, Matthieu Gautier, Pascal Scalart.

The FAON (Frequency based Access Optical Networks) project objectives are to demonstrate the technology and feasibility of a new type of Passive Optical Network (PON) for broadband access which uses a Frequency based shared access technique known as Frequency Division Multiplexing (FDM). These goals completely fall into the line of the expected capacity increase in PON which is today forecasted to go from 100 Mbps per user to 1 Gbps. For more details, see http://www.anr-faon.fr/. Faon involves Orange Labs, CEA-LETI, University of South Brittany (Lab-STICC laboratory) and University of Rennes 1 (Foton laboratory and CAIRNteam). CAIRNaims at developing a high-rate architecture at the receiver side. Specific receiver algorithms (synchronization and equalization) and FPGA implementation are the key issues that will be addressed.

7.1.3. *Equipex FIT - Future Internet (of Things)*

Participants: Vaibhav Bhatnagar, Arnaud Carer, Matthieu Gautier, Ganda-Stéphane Ouedraogo, Olivier Sentieys.

FIT is one of 52 winning projects from the first wave of the French Ministry of Higher Education and Research's "Équipements d'Excellence" (Equipex) research grant programme. FIT involves UPMC, Inria, LSIIT and the Institut Mines-Telecom and runs over a nine-year period. FIT offers a federation of several independent experimental testbeds to provide a larger-scale, more diverse and higher performance platform for accomplishing advanced experiments. For more details, see http://fit-equipex.fr/. Inria (CAIRNand Socrate teams) develops the cognitive radio testbed that will provide a full experimental environment for evaluating the coexistence and the cooperation between heterogeneous multistandard nodes. To this aim, a fully open architecture based on software defined radio nodes is developed. CAIRNaims at proposing an FPGA based software defined radio with high level specifications. Cognitive radio testbed development is supported by an ADT funding of Inria.

7.1.4. *ANR Ingénérie Numérique et Sécurité - ARDyT (2011-2015)*

Participants: Arnaud Tisserand, Thomas Chabrier, Philippe Quémerais.

ARDyT (in French: *Architecture Reconfigurable Dynamiquement Tolérante aux fautes*) is a project on a Reliable and Reconfigurable Dynamic Architecture. It involves IRISA-CAIRN (Lannion), Lab-STICC (Lorient), LIEN (Nancy) and ATMEL. The purpose of the ARDyT project is to provide a complete environment for the design of a fault tolerant and self-adaptable platform. Then, a platform architecture, its programming environment and management methodologies for diagnosis, testability and reliability have to be defined and implemented. The considered techniques are exempt from the use of hardened components for terrestrial and aeronautics applications for the design of low-cost solutions. The ARDyT platform will provide a European alternative to import ITAR constraints for fault-tolerant reconfigurable architectures. For more details see http://ardyt.irisa.fr.

7.1.5. *ANR Ingénérie Numérique et Sécurité - COMPA (2011-2015)*

Participants: Emmanuel Casseau, Steven Derrien, Antoine Courtay, Mythri Alle.

COMPA (model oriented design of embedded and adaptive multiprocessor) is a project which involves CAIRN, IETR (Institut d'Electronique et de Télécommunications de Rennes), Lab-STICC (University of Bretagne Sud), CAPS Entreprise, and Modae Technologies. The goal of the project is to design adaptive multiprocessor embedded systems to the execute dataflow programs. The use case is Reconfigurable video coding (RVC) standard. More specifically, we focus on the portable and platform-independent RVC-CAL language to describe the applications. We use transformations to refine, increase parallelism and translate the application model into software and hardware components. Task mapping, instruction and processor allocation, and specific scheduling are also investigated for runtime execution and reconfiguration.

7.1.6. *ANR Ingénérie Numérique et Sécurité - DEFIS (2011-2015)*

Participants: Olivier Sentieys, Daniel Menard [external collaborator], Romuald Rocher, Nicolas Simon.

DEFIS (Design of fixed-point embedded systems) is a project which involves CAIRN, LIP6 (University of Paris VI), LIRMM (University of Perpignan), CEA LIST, Thales, Inpixal. The main objectives of the project are to propose new approaches to improve the efficiency of the floating-point to fixed-point conversion process and to provide a complete design flow for fixed-point refinement of complex applications. This infrastructure will reduce the time-to-market by automating the fixed-point conversion and by mastering the trade-off between application quality and implementation cost. Moreover, this flow will guarantee and validate the numerical behavior of the resulting implementation. The proposed infrastructure will be validated on two real applications provided by the industrial partners. For more details see http://defis.lip6.fr.

7.1.7. *ANR ARPEGE - GRECO (2010-2013)*

Participants: Olivier Sentieys, Olivier Berder, Arnaud Carer, Trong-Nhan Le.

Sensor network technologies and the increase efficiency of photovoltaic cells show that it is possible to reach communicating objects solutions with low enough power consumption to foresee the possibility of developing autonomous objects. Greco (GREen wireless Communicating Objects) is a project on the design of autonomous communicating object platforms (i.e. self-powered sensor networks). The aim is to optimize the power consumption based on (i) a modeling of the performance and power of the required blocks (RF front-end, converters, modem, peripherals, digital architecture, OS, software, power generator, battery, etc.) (ii) heterogeneous simulation models and tools, and (iii) the use of a real-time global "Power Manager". The final validation will be performed on various case studies: a monitoring system and an audio communication between firemen. A HW/SW prototyping (based on an CAIRN's PowWow platform with energy harvesting) and a simulation associating a precise modeling (virtual platform) of an object inserted in a network simulator-like environment will be developed as demonstrators. Greco involves Thales, Irisa-CAIRN, CEA List, CEA Leti, Im2nP, LEAT, Insight-SiP. For more details see http://greco.irisa.fr.

7.1.8. *Images and Networks competitiveness cluster - 100GFlex project (2010-2013)*

Participants: Olivier Sentieys, Arnaud Carer, Remi Pallas, Pascal Scalart.

Speed and flexibility are quickly increasing in the metropolitan networks. In this context, 100GFLEX studies the relevance of a new transmission scheme: the multiband optical OFDM at very-high rates (up to 100 Gbits/s). In this project we will study efficient algorithms (e.g. synchronization) and high-speed architectures for the digital signal processing of the optical transceivers. Due to the high rate of analog signals (sampling at more than 10Gsample/s), synchronizing and processing is real challenge. 100Gflex involves Mitsubishi-Electric R&D Center Europe, Institut Télécom, Ekinops, France Télécom, Yenista Optics, Foton and CAIRN.

7.2. European Initiatives

7.2.1. *FP7 FLEXTILES*

Participants: Olivier Sentieys, Emmanuel Casseau, Antoine Courtay, Daniel Chillet, Philippe Quémerais, Christophe Huriaux, Quang-Hoa Le.

> Program: FP7-ICT-2011-7
>
> Project acronym: Flextiles
>
> Duration: Oct. 2011 - Sep. 2014
>
> Coordinator: Thales
>
> Other partners: Thales (FR), UR1 (FR), KIT (GE), TU/e (NL), CSEM (SW), CEA LETI (FR), Sundance (UK)
>
> Project title: Self Adaptive Heterogeneous Manycore Based on Flexible Tiles

A major challenge in computing is to leverage multi-core technology to develop energy-efficient high performance systems. This is critical for embedded systems with a very limited energy budget as well as for supercomputers in terms of sustainability. Moreover the efficient programming of multi-core architectures, as we move towards manycores with more than a thousand cores predicted by 2020, remains an unresolved issue. The FlexTiles project will define and develop an energy-efficient yet programmable heterogeneous manycore platform with self-adaptive capabilities. The manycore will be associated with an innovative virtualisation layer and a dedicated tool-flow to improve programming efficiency, reduce the impact on time to market and reduce the development cost by 20 to 50%. FlexTiles will raise the accessibility of the manycore technology to industry - from small SMEs to large companies - thanks to its programming efficiency and its ability to adapt to the targeted domain using embedded reconfigurable technologies.

7.2.2. FP7 ALMA

Participants: Steven Derrien, Romuald Rocher, Olivier Sentieys, Maxime Naullet, Ali Hassan El-Moussawi.

> Program: FP7-ICT-2011-7
>
> Project acronym: Alma
>
> Project title: Architecture oriented paraLlelization for high performance embedded Multicore systems using scilAb
>
> Duration: Sep. 2011 - Aug. 2014
>
> Coordinator: KIT
>
> Other partners: KIT (GE), UR1 (FR), Recore Systems (NL), Univ. of Peloponnese (GR), TEI-MES (GR), Intracom SA (GR), Fraunhofer (GE)

The mapping process of high performance embedded applications to today's multiprocessor system on chip devices suffers from a complex toolchain and programming process. The problem here is the expression of parallelism with a pure imperative programming language which is commonly C. This traditional approach limits the mapping, partitioning and the generation of optimized parallel code, and consequently the achievable performance and power consumption of applications from different domains. The Architecture oriented paraLlelization for high performance embedded Multicore systems using scilAb (ALMA) project aims to bridge these hurdles through the introduction and exploitation of a Scilab-based toolchain which enables the efficient mapping of applications on multiprocessor platforms from high-level abstraction descriptions. This holistic solution of the toolchain allows the complexity of both the application and the architecture to be hidden, which leads to a better acceptance, reduced development cost and shorter time-to-market. Driven by the technology restrictions in chip design, the end of Moore's law and an unavoidable increasing request of computing performance, ALMA is a fundamental step forward in the necessary introduction of novel computing paradigms and methodologies. ALMA helps to strengthen the position of Europe in the world market of multiprocessor targeted software toolchains. The challenging research will be achieved by the unique ALMA consortium which brings together industry and academia. High class partners from industry such as Recore and Intracom, will contribute their expertise in reconfigurable hardware technology for multi-core systems-on-chip, software development tools and real world applications. The academic partners will contribute their outstanding expertise in reconfigurable computing and compilation tools development.

7.2.3. Collaborations with Major European Organizations

> Imec (Belgium), Scenario-based fixed-point data format refinement to enable energy-scalable of Software Defined Radios (SDR)
>
> Lund University (Sweden), Constraints programming approach application in the reconfigurable data-paths synthesis flow
>
> Code and Cryptography group of University College Cork (Ireland), Arithmetic operators for cryptography, side channel attacks for security evaluation, and WSN for health monitoring
>
> Ecole Polytechnique Fédérale de Lausanne - EPFL (Switzerland), Optimization of systems using fixed-point arithmetic
>
> Technical University of Madrid - UPM (Spain), Optimization of systems using fixed-point arithmetic
>
> Technical University of Tampere, University of Oulu (Finland), Reconfigurable Video Coding

7.3. International Initiatives

7.3.1. Inria International Partners

7.3.1.1. Declared Inria International Partners

> Computer Science Department, Colorado State University in Fort-Collins (USA), Loop parallelization, development of high-level synthesis tools, Inria Associate Team (2010-2012)

Electrical and Computer Engineering Department, University of Massachusetts at Amherst (USA), CAD tools for arithmetic datapath synthesis and optimization

7.3.1.2. Informal International Partners

LRTS laboratory, Laval University in Québec (Canada), Architectures for MIMO systems, Wireless Sensor Networks, Inria Associate Team (2006-2008)

LSSI laboratory, Québec University in Trois-Rivières (Canada), Design of architectures for digital filters and mobile communications

7.3.2. CNRS PICS - SPiNaCH (2012 - 2014)

Title: Secure and low-Power sensor Networks Circuits for Healthcare embedded applications

Principal investigator: Arnaud Tisserand, Olivier Berder, Olivier Sentieys

International Partner (Institution - Laboratory - Researcher): Code&Crypto group in University College Cork (Ireland)

Duration: 2012 - 2014

Biomedical sensor networks may be used more and more in the future. For instance, they allow patient's health-care parameters to be remotely monitored at home. In this project, we plan to address two important challenges in the design of biomedical sensors networks: i) design of low-power sensor devices for embedded autonomous systems (health monitoring, pace-maker...) with long battery life; ii) confidentiality and security aspects and especially with public key cryptography processor that are robust against side channel attacks (measure of the computation time, the power consumption or the electromagnetic radiations of the circuit) and with limited power-energy resources.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Prof. Russel Tessier (University of Massachusetts, UMass Reconfigurable Computing Group, USA) for one month in June-July (Visiting professor position from University Rennes 1).

Prof. Liam Marnane (University College Cork, Ireland) for one month in June (Visiting professor position from University Rennes 1).

Prof. Emanuel Popovici (University College Cork, Ireland) for two weeks in July (Visiting professor position from University Rennes 1).

Prof. Manav Bhatnagar, (Department of Electrical Engineering, Indian Institute of Technology, Delhi, India) for two weeks in December (Visiting professor position from University Rennes 1).

Dr. Michele Magno, post-doc, (University College Cork, Ireland) for one week in July (funded by CNRS PICS SpiNaCH project).

7.4.2. Internships

Participant: Simara Pérez Zurita.

Subject: Optimizing Computational Precision in High-level Synthesis of Signal Processing Systems: Theory and Implementation using TDS and GECOS

Date: from Oct 2012 until Aug 2013

Institution: *Technical University of Kaiserslautern* (Kaiserslautern, Germany)

Participant: Rengarajan Ragavan.

Subject: Reconfigurable Microtasks for Ultra-Low Power Wireless Sensor Network Nodes

Date: from Jan 2013 until Jul 2013

Institution: *Linkoping University* (Linkoping, Sweden)

Participant: Amith Vikram Pai.

Subject: Design and Validation of a Low-Power Embedded FPGA

Date: from Jan 2013 until Jun 2013

Institution: Birla Institute of Technology and Science, Pilani (India)

CELTIQUE Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

The Celtique team collaborates with DGA-MI, a research laboratory belonging to the French army, and located in Rennes. The collaboration has several facets.

- We run a joint bi-monthly seminar on Security and Formal Methods. This seminar attracts attendance from academia and industry.
- DGA-MI is funding a PhD thesis, supervised jointly, on code obfuscation.
- Colas Le Guernic, a DGA-MI researcher, is external collaborator of Celtique on our activities on analysis of binary code.

7.2. National Initiatives

7.2.1. *The PiCoq ANR project*

Participants: Alan Schmitt, Petar Maksimovic.

Process calculi, Verification, Proof Assistants

The goal of the (PiCoq project) is to develop an environment for the formal verification of properties of distributed, component-based programs. The project's approach approach lies at the interface between two research areas: concurrency theory and proof assistants. Achieving this goal relies on three scientific advances, which the project intends to address:

- Finding mathematical frameworks that ease modular reasoning about concurrent and distributed systems: due to their large size and complex interactions, distributed systems cannot be analysed in a global way. They have to be decomposed into modular components, whose individual behaviour can be understood.
- Improving existing proof techniques for distributed/modular systems: while behavioural theories of first-order concurrent languages are well understood, this is not the case for higher-order ones. We also need to generalise well-known modular techniques that have been developed for first-order languages to facilitate formalization in a proof assistant, where source code redundancies should be avoided.
- Defining core calculi that both reflect concrete practice in distributed component programming and enjoy nice properties w.r.t. behavioural equivalences.

The project partners include Inria, LIP, and Université de Savoie. The project runs from November 2010 to October 2014.

7.2.2. *The ANR VERASCO project*

Participants: Sandrine Blazy, Delphine Demange, Vincent Laporte, André Oliveira Maroneze, David Pichardie.

Static program analysis, Certified static analysis

The VERASCO project (2012–2015) is funded by the call ISN 2011, a program of the Agence Nationale de la Recherche. It investigates the formal verification of static analyzers and of compilers, two families of tools that play a crucial role in the development and validation of critical embedded software. It is a joint project with the Inria teams ABSTRACTION, GALLIUM, The VERIMAG laboratory and the Airbus company.

7.2.3. *The ANR Binsec project*

Participants: Frédéric Besson, Sandrine Blazy, Pierre Wilke.

Binary code, Static program analysis

The Binsec project (2013–2017) is founded by the call ISN 2012, a program of the Agence Nationale de la Recherche. The goal of the BINSEC project is to develop static analysis techniques and tools for performing automatic security analyses of binary code. We target two main applicative domains: vulnerability analysis and virus detection.

Binsec is a joint project with the Inria CARTE team, CEA LIS, VERIMAG, EADS IW and VUPEN SECURITY. ABSTRACTION, The VERIMAG laboratory and the Airbus company.

7.2.4. *Labex COMIN Labs Seccloud project*

Participants: Frédéric Besson, Nataliia Bielova, Thomas Jensen, Alan Schmitt, Martin Bodin.

The SecCloud project, started in 2012, will provide a comprehensive language-based approach to the definition, analysis and implementation of secure applications developed using Javascript and similar languages. Our high level objectives is to enhance the security of devices (PCs, smartphones, ect.) on which Javascript applications can be downloaded, hence on client-side security in the context of the Cloud. We will achieve this by focusing on three related issues: declarative security properties and policies for client-side applications, static and dynamic analysis of web scripting programming languages, and multi-level information flow monitoring.

This is a joint project with Supelec Rennes and Ecole des Mines de Nantes.

7.3. International Initiatives

7.3.1. *Inria International Partners*

7.3.1.1. *Informal International Partners*

A strong collaboration is ongoing with researchers from Imperial College (UK) in the setting of the JSCert project (http://jscert.org/). This project aims at really understanding JavaScript by building models of ECMAScript semantics in the Coq proof assistant, and certifying automated logical reasoning tools built on those semantics. We are closely working with Philippa Gardner and Sergio Maffeis. This collaboration has resulted in a large Coq development including a formal semantics for JavaScript and a certified JavaScript interpreter. These results are described in our POPL 2014 paper [24].

In 2013, Martin Bodin, Thomas Jensen, and Alan Schmitt visited Imperial College twice. Daiva Naudziuniene, a PhD student of Philippa Gardner, also did a one month internship in the Celtique team in the setting of this collaboration.

David Pichardie was on sabbatical in 2012, in Jan Vitek's group at Purdue University, Indiana, USA. The strong collaboration is still ongoing, and an Associate Team proposal for 2014-2016 has been submitted in 2013 as part of an Inria International program. The JCert project research aims at verifying the compilation of concurrent managed languages, following the previous outcomes of the informal collaboration – a new memory model for concurrent Java that is more suitable to formal verification [26], as well as refinement-based proof methodology (under submission) that allows to reason compositionally about the atomicity of low-level concurrent code fragments. If the proposal is accepted, David Pichardie would be the Inria principal investigator of the JCert project, and Delphine Demange, Thomas Jensen, and Vincent Laporte will also be active participants.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

7.4.1.1. Internships

Patricio Palladino

Subject: Protection from Web Tracking: Analysis of web browser fingerprints

Date: from Mar 2013 until Apr 2013

Institution: University of Buenos Aires (Argentina)

7.4.2. Visits to International Teams

David Pichardie took a sabbatical year and visited Greg Morrisett's group at Harvard University, Cambridge, USA in 2013. During this sabbatical, he worked on the DARPA SAFE project with Harvard University and UPenn University [17].

CIDRE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- **Région Bretagne ARED grant:** the PhD of Regina Marin on privacy protection in distributed social networks is supported by a grant from the Région Bretagne.

- **Labex COMINLAB contract (2012-2015): "POSEIDON"**

  POSEIDON deals with the protection of data in outsourced or shared systems such as cloud computing and peer-to-peer networks. While these approaches are very promising solutions to outsource storage space, contents, data and services, they also raise serious security and privacy issues since users lose their sovereignty on their own data, services and systems. Instead of trying to prevent the bad effects of the cloud and of peer-to-peer systems, the main objective of the POSEIDON project is to turn benefit from their main characteristics (distribution, decentralization, multiple authorities, etc.) to improve the security and the privacy of the users' data, contents and services.

  This project is conducted in cooperation with Télécom Bretagne and Université de Rennes I. The PhD of Julien Lolive (co-supervised by Sébastien Gambs and Caroline Fontaine), which deals with the entwining of identification and privacy mechanisms, is funded by the POSEIDON project.

- **Labex COMINLAB contract (2012-2015): "SecCloud"**

  Nowadays attacks targeting the end-user and especially its web browser constitute a major threat. Indeed web browsers complexity has been continuously increasing leading to a very large attack surface. Among all possible threats, we tackle in the context of the SecCloud project those induced by client-side code execution (for example javascript, flash or html5).

  Existing security mechanisms such as os-level access control often only rely on users identity to enforce the security policy. Such mechanisms are not sufficient to prevent client-side browser attacks as the web browser is granted the same privileges as the user. Consequently, a malicious code can perform every actions that are allowed to the user. For instance, it can read and leak user private data (credit cart numbers, registered passwords, email contacts, etc.) or download and install malware.

  One possible approach to deal with such threats is to monitor information flows within the web browser in order to enforce a security information flow policy. Such a policy should allow to define fine-grained information flow rules between user data and distant web sites. This implies to propose an approach and to design and implement a mechanism that can handle both OS-level and browser-level information flows.

  Dynamically monitoring information flow at the web browser level may dramatically impact runtime performances of executed codes. Consequently, an important aspect of this work will be to benefit as far as possible from static analysis of application code. This static-dynamic hydride approach should reduce the number of verifications performed at run time.

  This study is conducted in cooperation with other Inria Teams (Ascola and Celtique). Deepak Subramanian is doing his PhD in the context of this project.

- **Labex COMINLAB contract (2013-2016): "DeSceNt"**

  In DeSceNt, we propose to investigate how decentralized home-based networks of plug computers can support personal clouds according to sound architectural principles, mechanisms, and programming abstractions. To fulfill this vision we see three core scientific challenges, which we think must be overcome. The first challenge, decentralized churn-poor design, arises from the nature of plug federations, which show much lower levels of churn than traditional peer-to-peer environments. The

second challenge, quasi-causal consistency, is caused by the simultaneous needs to produce a highly scalable environment (potentially numbering millions of users), that also offers collaborative editing capabilities of mutable data-structures (to offer rich social interactions). The third and final challenge, intuitive data structures for plug programming, arises from the need by programmers for intuitive and readily reusable data-structures to rapidly construct rich and robust decentralized personal cloud applications.

This study is conducted in cooperation with other teams (GDD Team (University of Nantes), EPI ASAP)

8.2. National Initiatives

8.2.1. ANR

- **ANR INS Project: AMORES (2011-2015) - http://amores-project.org/**

  Situated in the mobiquitous context characterized by a high mobility of individuals, most of them wearing devices capable of geolocation (smartphones or GPS-equipped cars), the AMORES project is built around three use-cases related to mobility, namely (1) dynamic carpooling, (2) real-time computation of multi-modal transportation itineraries and (3) mobile social networking. For these three use cases, the main objective of the AMORES project is to define and develop geo-communication primitives at the middleware level that can offer the required geo-located services, while at the same time preserving the privacy of users, in particular with respect to their location (notion of geo-privacy). Within this context, we study in particular the problem of anonymous routing and the design of a key generation protocol tied to a particular geographical location. Each of these services can only work through cooperation of the different entities composing the mobile network. Therefore, we also work on the development of mechanisms encouraging entities to cooperate together in a privacy-preserving manner. The envisioned approach consists in the definition of generic primitives such as the management of trust and the incentive to cooperation. This project is joint between the Université de Rennes I, Supélec, LAAS-CNRS, Mobigis and Tisséo. The research project AMORES received the Innovation Award at the Toulouse Space Show last June. Simon Boche and Paul Lajoie-Mazenc are doing their PhD in the context of this project.

- **ANR INS Project: LYRICS (2011-2014) - http://projet.lyrics.orange-labs.fr/**

  With the fast emergence of the contactless technology such as NFC, mobile phones will soon be able to play the role of e-tickets, credit cards, transit pass, loyalty cards, access control badges, e-voting tokens, e-cash wallets, etc. In such a context, protecting the privacy of an individual becomes a particularly challenging task, especially when this individual is engaged during her daily life in contactless services that may be associated with his identity. If an unauthorized entity is technically able to follow all the digital traces left behind during these interactions then that third party could efficiently build a complete profile of this individual, thus causing a privacy breach. Most importantly, this entity can freely use this information for some undesired or fraudulent purposes ranging from targeted spam to identity theft. The objective of LYRICS (ANR INS 2011) is to enable end users to securely access and operate contactless services in a privacy-preserving manner that is, without having to disclose their identity or any other unnecessary information related to personal data. Within this project, we work mainly on the privacy analysis of the risks incurred by users of mobile contactless services as well as on the development of the architecture enabling the development of privacy-preserving mobile contactless services. The project is joint between France Télécom, Atos Wordline, CryptoExperts, ENSI Bourges, ENSI Caen, MoDyCo, Oberthur Technologies, NEC Corporation, Microsoft and Université de Rennes I.

8.2.2. Inria Project Labs

- **CAPPRIS (2012-2016)**

CAPPRIS stands for "Collaborative Action on the Protection of Privacy Rights in the Information Society". The main objective of CAPPRIS is to tackle the privacy challenges raised by the most recent developments and usages of information technologies such as profiling, data mining, social networking, location-based services or pervasive computing by developing solutions to enhance the protection of privacy in the Information Society. To solve this generic objective, the project focuses in particular on the following four fundamental issues:

–   The design of appropriate metrics to assess and quantify privacy, primarily by extending and integrating the various possible definitions existing for the generic privacy properties such as anonymity, pseudonymity, unlinkability and unobservability, as well as notions coming from information theory or databases such as the recent but promising concept of differential privacy;

–   The definition and the understanding of the fundamental principles underlying "privacy by design", with the hope of deriving practical guidelines to implement notions such as data minimization, proportionality, purpose specification, usage limitation, data sovereignty and accountability directly in the formal specifications of our information systems;

–   The integration between the legal and social dimensions, intensely necessary since the developed privacy concepts, although they may rely on computational techniques, must be in adequacy with the applicable law (even in its heterogeneous and dynamic nature). In particular, privacy-preserving technologies cannot be considered efficient as long as they are not properly understood, accepted and trusted by the general public, an outcome which cannot be achieved by the means of a mathematical proof.

Three major application domains have been identified as interesting experimentation fields for this work: online social networks, location-based services and electronic health record systems. Each of these three domains brings specific privacy-related issues. The aim of the collaboration is to apply the techniques developed to the application domains in a way that promotes the notion of privacy by design, instead of simply considering them as a form of privacy add-ons on the top of already existing technologies. CAPPRIS is a joint project between Inria, LAAS-CNRS, Université de Rennes I, Supélec, Université de Namur, Eurecom, and Université de Versailles.

8.2.3. Research mission "Droit et Justice"

* **Droit à l'oubli (2012-2014)**

The "right to be forgotten" can be viewed as a consequence and an extension of the right to privacy and to personal data protection, emphasized by the inherent difficulty to erase any given information from the omnipresent digital world. The French ministry of Justice has launched two twin projects (one of which is the DAO project), in order to explore the possible legal definitions of a "right to be forgotten". Even though there are no legal foundations for such a right in France at the moment, the concept is already known from the general public and is also present in courts. Furthermore, individuals expect to be protected by such a right, thus it is important to understand why, how, in which circumstances and to which extent this new right may apply before envisioning a legal notion defining it. The DAO project involves a major legal component, a sociological survey and a technical study. In a nutshell, the legal part explores the possible boundaries and requirements of a right to be forgotten with respect to labor law, civil statuses, personal data protection, legal prescription and IT law. The sociological survey aims at understanding the root causes making people build a desire for forgetfulness in others. Finally, the objective of the computer science part is to elaborate a state of the art of the techniques that could be used to enforce a right to be forgotten in practice in the digital world. The expected output of the project as a whole is a detailed recommendation about whether an independent legislation proposal for the right to be forgotten would be justified, and how it should be done. The project is joint between Université de Rennes I, Inria and Supélec.

8.2.4. Competitivity Clusters

The AMORES project (ANR INS 2011, http://www.images-et-reseaux.com/en/content/amores) is recognized by the Images & Réseaux cluster.

8.3. European Initiatives

8.3.1. FP7 Projects

The **PANOPTESEC** project started on the 1st of November 2013. It deals with the automated and assisted security management of SCADA system. The main objective of PANOPTESEC is to provide an integrated solution that will allow to efficiently monitor SCADA systems, detect intrusions and react to them. To that end, it encompasses many of the research topics that are addressed by the CIDre team: alerts aggregation and correlation, policy-aware intrusion detection, architecture-aware intrusion detection, automated trust management, trust-based automated reaction and visualization. The CIDre team is envolved in the project on all of these aspects. The partners are REHA, Alcatel-Lucent Bell Labs France, Epistematica, The university of Rome, the university of Hamburg, the institut Mines-Telecom, ACEA and Supelec.

8.3.2. Collaborations in European Programs, except FP7

Program: EIT ICT labs

Project acronym: "Privacy, security and trust in information society" action line

Project title: "Security and privacy for location-based services" activity

Duration: January 2012 - December 2013

Coordinator: Sébastien Gambs

Other partners: KTH (Sweden), Privatics Inria team (France), Alcatel-Lucent (France), University of Trento (Italy), DFKI (Germany).

Abstract: The main objective of this activity is to address the issues of privacy and security for location-based services. More precisely, the main outcomes of this activity are (1) secure and privacy-preserving implementations of location-based services (for instance traffic monitoring), (2) tools to raise the public awareness about the privacy issues in such context but also to help a user to prevent/limit privacy leaks (thus contributing to the protection of privacy), (3) demonstrators to secure the position of an individual and (4) the application of the results and findings of the activity to other thematic Action Lines of EIT ICT labs.

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

8. Partnerships and Cooperations

8.1. International Research Visitors

8.1.1. Inria International Chair

Participants: Bruno Tuffin, Pierre L'Ecuyer.

Title: Methods and Tools for Effective Stochastic Simulation

Period: Nov 2013 - Oct 2018

The activity deals with mathematical models that represent uncertainty in the dynamic behavior of complex systems, algorithms for efficient simulation of these systems on a computer, eventually with the aim of optimizing management decisions taken with respect to these systems, and computer software that concretely implements these methods efficiently. It applies to several types of systems that involve uncertainty, in all areas. The main part of the work is on general-purpose methodology and tools, and their mathematical analysis. Another part focuses on specific classes of applications in the areas of communications networks, reliability, finance, revenue management and network economics, and service systems such as call center or health care management. It has connections with computer science, operations research, industrial engineering, applied probability, statistics, and numerical analysis. Stochastic simulation is a key tool in practically all areas of science, engineering, and management. Its use keeps growing quickly, and new research issues pop up along the way, as the amount of available digital data on complex stochastic systems is literally exploding. Effective ways of using this large flow of data for better stochastic modeling, simulation, and decision making for those systems need to be developed, and this gives rise to large challenges.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. FP7 PROBE-IT
Participants: César Viho, Anthony Baire, Nanxing Chen.

PROBE-IT was a two years European project that aims at supporting exploitation of European research advances in IoT deployments. The work plan was split in three main areas : benchmarking, roadmap and interoperability testing. PROBE-IT comprised ten international partners from Europe, China, Brazil and Africa. Dionysos was leader of the work-package WP4 dedicated to testing roadmap and solutions to provide stakeholders with elements to validate technologies conformance and interoperability. The project ended in September 2013 See http://www.probe-it.eu

8.2.2. Collaborations with Major European Organizations

Partner 1: FTW, Vienna (Austria)

We work with FTW on network economics.

Partner2: Universidad Politécnica de Valencia

We work with UPV on network economics.

Partner 3: Vrije University (The Netherlands)

We work with Vrije University on rare event simulation.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. MANAP

Title: Markovian ANalysis and APplications

Inria principal investigator: Gerardo Rubino

International Partner (Institution - Laboratory - Researcher):

> Technical University Federico Santa María (UTFSM), Valparaíso, Chile – Electronics Department – Prof. Reinaldo Vallejos

Starting: 2013

From the theoretical side, MANAP addresses the main problem when using Markov models today in order to analyze complex communication systems, the combinatorial explosion of the state space and its negative consequences on the cost of the associated solving procedures. We focus on the design of acceleration methods capable of reducing the computational complexity of the evaluation of metrics defined on these models. From the application viewpoint, the focus is on (i) the performance analysis of WDM communication infrastructures, taking into account the possibility of failing components, and (ii) the dependability analysis of Wireless Local Area Networks (WLANs). The activities started in 2013, where we launched a project around a new idea for solving numerically basic Markov problems: the computation of the distribution of the model in transient and in steady-state.

See also: http://people.rennes.inria.fr/Gerardo.Rubino/RESEARCH/MANAP/manap.html

8.3.1.2. MOCQUASIN

Title: Monte Carlo and Quasi-Monte Carlo for rare event simulation

Inria principal investigator: Bruno Tuffin

International Partner (Institution - Laboratory - Researcher):

> University of Montreal (Canada) - Département d'informatique et recherche opérationnelle - Pierre L'Ecuyer

Duration: 2008 - 2013

See also: http://www.irisa.fr/dionysos/pages_perso/tuffin/MOCQUASIN/

The goal of MOCQUASIN is to design efficient Monte Carlo and quasi-Monte Carlo simulation methods and to apply them to models in telecommunications. Simulation is indeed often the only method to analyse complex and/or large systems, but also suffers from inefficiency. Two specific situations on which we will focus are rare events, and revenue management. In the two cases, we want to deal with dependent individual events or decisions, a realistic situation requiring adapted solution techniques. The inefficiency of the standard simulation is a known issue to compute the probability of rare event since getting it only once requires in average a long simulation time, but most of the literature has up to now assumed independence in the models. The other framework, revenue management in telecommunications, is the situation of providers trying to define valid offers and capacity investments in front of complex demand models. Here too, a change in the decision of an actor has an impact on the others that has to be taken into account.

8.3.2. *"International activity" action from the University Rennes 1*

Action funded by the University of Rennes 1 studying ads ranking (e-commerce, search engines) with their economic impact. Collaboration with Pierre L'Ecuyer (Université de Montréal).

8.3.3. *Inria International Partners*

Our other main international partners are:

- Peter Reichl (from FTW, Vienna, Austria), on pricing and security issues;
- Héctor Cancela and Franco Robledo (from Univ. of the Republic, Montevideo, Uruguay), on simulation issues (see 8.3.5.1);
- Tarik Taleb (from NEC Europe), on LTE issues;
- Alan Krinik, CalPoly, California, USA, on transient analysis of Markovian queues;
- Reinaldo Vallejo, UTFSM, Valparaíso, Chile, on networking and modeling problems (see 8.3.1.1 and 8.3.5.1).

8.3.4. Inria International Labs

In the context of CIRIC, we cooperate with the team of Reinaldo Vallejo, professor at the UTFSM, Valparaíso, Chile, on different topics related to networking and modeling issues. Specifically, these activities are organized around two collaborative projects, 8.3.1.1 and 8.3.5.1 , where one can find the scientific details.

8.3.5. Participation In other International Programs

8.3.5.1. Stic AmSud with UDELAR, Uruguay, and UTFSM, Chile

Program: Stic AmSud

Title: Accelerating Markov Models for analysis and design of dynamic WDM optical networks (AMMA)

Inria principal investigator: Gerardo Rubino

International Partners (Institution - Laboratory - Researcher):

> University of the Republic (UDELAR), Montevideo, Uruguay – Computer Science at the Engineering Faculty – prof. Héctor Cancela

> Technical University Federico Santa María (UTFSM), Valparaíso, Chile – Electronics Department – Prof. Reinaldo Vallejos

Duration: 2 years, Jan. 2013 – Dec. 2014

This project has two main scientific goals: (i) to develop methods capable of solving Markov models faster than with state-of-the-art techniques, and (ii) to apply these techniques to the design of fault-tolerant optical networks. The rationale behind (i) is that the group has ideas and some preliminary promising unpublished results that makes it expect that its approach will be effective in producing new nice solving procedures. Concerning (ii), we have already produced results in simpler cases (without taking into account failures), and we also have results on all the associated areas (dependability analysis, combinatorial optimization, etc.). These main research lines are completed with other goals all concerned with the quantitative analysis of such complex communication systems.

8.3.5.2. Math AmSud with UDELAR, Uruguay, and UV, Chile

Program: Math AmSud

Title: Stochastic Analysis, Statistics Inference, Numerical Analysiss (SIN)

Inria principal investigator: Gerardo Rubino

Main International Partners (Institution - Laboratory - Researcher):

> University of the Republic (UDELAR), Montevideo, Uruguay – Computer Science at the Engineering Faculty – prof. Paola Bermolen

> University of Valparaíso, Chile — Prof. Soledad Torres

Duration: 2 years, Jan. 2013 – Dec. 2014

Stochastic calculus with respect to the standard Brownian motion or more generally with respect to semi-martingales is currently one of the most important components of international research in probability theory. The applications of this theory largely exceed the original probabilistic framework and have repercussions in various fields, including differential geometry, differential partial equations, theoretical physics, modeling in finance, hydrology, telecommunications and biology. Recently, many authors have been interested in developing a stochastic calculus with respect to Gaussian processes which are not necessarily semi-martingales, as for instance the well known fractional Brownian motion. This research project is articulated around the analysis and the applications of stochastic differential equations driven by long memory processes.

SIN is a large project with many partners. Our team participates in looking at differential equations and stocastic differential equations as limits of discrete Markov processes.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Professors

Pr. Luis Guijarro

Subject: Economics of cognitive radio networks

Institution: UP Valencia (Spain)

Duration: 1/06/2013 - 31/07/2013

Pr. Héctor Cancela

Subject: network reliability (see 8.3.5.1)

Institution: UDELAR, Montevideo, Uruguay

Duration: 10 days, Jul 2013

Pr. Reinaldo Vallejo and Marta Barría

Subject: network modeling and Markov chain analysis (see 8.3.5.1 , 8.3.1.1 , 8.3.4)

Institutions: UTFSM and UV, Valparaíso, Chile

Duration: two weeks, Sep 2013

8.4.2. Visits to International Teams

- G. Rubino visited the Design and Analysis of Communication Systems (DACS) at the University of Twente, The Netherlands, where he gave a seminar.

- C. Viho visited the Institute of Computer Science at the University of Goettingen (Germany) and the Computer Science and Engineering Department of BUPT (Beijing University of Post and Telecommunications), China, where he gave seminars.

DREAM Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Projet RTR: Coupling observation/simulation for decision-aid in environment complex systems

Participants: Sid Ahmed Benabderrahmane, Marie-Odile Cordier, Thomas Guyet, Simon Malinowski, René Quiniou.

This RTR (Réseaux Thématiques de Recherche - Thematic Research Networks) project is a collaboration between COSTEL (UMR LETG, Rennes), the team Obelix (IRISA, Vannes), UMR SAS (INRA, Rennes) and the EPI Dream. The project began in 2013 and has been funded for one year. It aims at studying the relationships between observations and simulations. The objective is to better understand what one side can provide to the other side in order to improve decision-making. This project gathers partners having expertise and skills in teledetection and image analysis, in modeling and simulation, and in knowledge acquisition for aiding decision in environmental research. The targeted applications belong to the domain of hydrology and agriculture. A final workshop (http://tinyurl.com/k3smbox) has been organized in november.

8.2. National Initiatives

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

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

The ACASSYA project (ACcompagner l'évolution Agro-écologique deS SYstèmes d'élevage dans les bassins versants côtiers) is funded by ANR/ADD. It started at the beginning of 2009 and will end in June 2013. The main partners are our colleagues from INRA (SAS from Rennes. One of the objectives is to develop modeling tools supporting the management of ecosystems, and more precisely the agro ecological evolution of breeding systems in coastal watersheds. In this context, the challenge is to transform existing simulation tools (as SACADEAU or TNT2 into decision-aid tools, able to answer queries or scenarios about the future evolution of ecosystems. (http://tinyurl.com/ptzdqo5)

8.2.2. Asterix : spatio-temporal analysis of remote sensing images

Participant: Thomas Guyet.

The ASTERIX project (Analyse Spatio-temporelle pour la Télédétection de l'Environnement par Reconnaissance dans les Images compleXes) is funded by ANR/JCJC. The project leader is S. Lefèvre from the IRISA/Vannes Team Obelix. The other partners are OSUR/University of Rennes-2, the Laboratory Image, Ville, Environnement (LIVE), University of Strasbourg, DYNAFOR (INRA/ENSAT), Toulouse and Institut de Physique du Globe de Strasbourg (IPGS), University of Strasbourg. The project started at the end of 2013 (http://anr-asterix.irisa.fr/) and will end in 2017.

The goal of the ASTERIX project is to provide methods, algorithms and software in the field of image analysis and machine learning/data mining to support the analysis of remote sensing images. The project addresses the specific issues of such data: dimensionality, heterogeneity, volume, spatio-temporal nature and the temporal evolution. It is dedicated to the field of environmental remote sensing and deals with concrete applications such as the evolution of the coastline or the colonization of grasslands by ash.

Our contribution to this project will be the proposition of data mining algorithms to deal with the spatio-temporal dimensions of satellite image time series.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Declared Inria International Partners

- University of Potsdam, Germany. Prof. Torsten Schaub has been awarded an Inria international senior grant from 2103 to 2017.

8.3.1.2. Informal International Partners

- University of Calgary, Canada. Dr Edouard Timsit, Dept. of production Animal Health, Faculty of Veterinary, Medicine.
- University di Torino, Italy, Dr Roberto Micalizio, Dept. of Computer Science.

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

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. *Regional partnership with computer science laboratories in Nantes*

Participants: Anne Siegel, Jérémie Bourdon, Damien Eveillard, François Coste, Jacques Nicolas, Oumarou Abdou-Arbi, Vincent Picard, Santiago Videla, Sven Thiele.

Methodologies are developed in close collaboration with university of Nantes (LINA) and Ecole centrale Nantes (Irccyn). This is acted through the Biotempo and Idealg ANR projects and co-development of common software toolboxes within the Renabi-GO platform process. The Ph-D students V. Picard and J. Laniau are also co-supervised with members of the LINA laboratory.

7.1.2. *Regional partnership in Marine Biology*

Participants: Anne Siegel, Catherine Belleannée, Jérémie Bourdon, Jeanne Cambefort, François Coste, Damien Eveillard, Jacques Nicolas, Guillaume Collet, Clovis Galiez, Gaëlle Garet, Julie Laniau, Vincent Picard, Sylvain Prigent.

A strong application domain of the Dyliss project is marine Biology. This application domain is co-developed with the station biologique de Roscoff and their three UMR and involves several contracts. The IDEALG consortium is a long term project (10 years, ANR Investissement avenir) aiming at the development of macro-algae biotechnology. Among the research activities, we are particularly interested in the analysis and reconstruction of metabolism and the characterization of key enzymes. Other research contracts concern the modeling of the initiation of sea-urchin translation (former PEPS program Quantoursin, Ligue contre le cancer and ANR Biotempo), the analysis of extremophile archebacteria genomes and their PPI networks (former ANR MODULOME and PhD thesis of P.-F. Pluchon) and the identification of key actors implied in competition for light in the ocean (PELICAN ANR project).

7.1.3. *Regional partnership with Inra and Health*

Participants: Oumarou Abdou-Arbi, Geoffroy Andrieux, Aymeric Antoine-Lorquin, Catherine Belleannée, Charles Bettembourg, François Coste, Olivier Dameron, Michel Le Borgne, Jacques Nicolas, Anne Siegel, Valentin Wucher.

We have a strong and long term collaboration with biologists of INRA in Rennes : PEGASE and IGEEP units. This partnership is acted by the co-supervision of one post-doctorant and the co-supervision of several PhD students. The Ph-D thesis of O. Abdou-Arbi [11] and C. Bettembourg were supported by collaborations with the PEGASE laboratory [14]. This collaboration is also reinforced by collaboration within ANR contracts (Lepidolf, MirNadapt, FatInteger).

We also have a strong and long term collaboration with the IRSET laboratory at Univ. Rennes 1, acted by the defense of the co-supervised Ph-D thesis of G. Andrieux [12]. This partnership is reinforced by the ANR contract Biotempo. It was also supported in the framework of the previous CPER by a project, BasicLab, on a lab on chip for cell assays. Future studies will focus on the understanding of the metabolism of xenobiotics, funded by Anses.

7.2. National Initiatives

7.2.1. *Long-term contracts*

7.2.1.1. *"Omics"-Line of the Chilean CIRIC-Inria Center*

Participants: Anne Siegel, Jérémie Bourdon, François Coste, Damien Eveillard, Gaëlle Garet, Jacques Nicolas, Andres Aravena, Sven Thiele, Santiago Videla.

Cooperation with Univ. of Chile (MATHomics, A. Maass) on methods for the identification of biomarkers and software for biochip design. It aims at combining automatic reasoning on biological sequences and networks with probabilistic approaches to manage, explore and integrate large sets of heterogeneous omics data into networks of interactions allowing to produce biomarkers, with a main application to biomining bacteria. Co-funded by Inria and CORFO-chile from 2012 to 2022, the program includes a co-advised Ph-D student (A. Aravena) [13] and a post-doc (S. Thiele). In this context, IntegrativeBioChile is an Associate Team between Dyliss and the Laboratory of Bioinformatics and Mathematics of the Genome hosted at Univ. of Chile funded from 2011 to 2013.

7.2.1.2. ANR Idealg

Participants: Anne Siegel, Catherine Belleannée, Jérémie Bourdon, Jeanne Cambefort, François Coste, Olivier Dameron, Damien Eveillard, Jacques Nicolas, Guillaume Collet, Clovis Galiez, Gaëlle Garet, Sylvain Prigent.

IDEALG is one of the five laureates from the national call 2010 for Biotechnology and Bioresource and will run until 2020. It gathers 18 different partners from the academic field (CNRS, IFREMER, UEB, UBO, UBS, ENSCR, University of Nantes, INRA, AgroCampus), the industrial field (C-WEED, Bezhin Rosko, Aleor, France Haliotis, DuPont) as well as a technical center specialized in seaweeds (CEVA) in order to foster biotechnology applications within the seaweed field. It is organized in ten workpackages. We are participating to workpackages 1 (establishment of a virtual platform for integrating omics studies on seaweed) and 4 (Integrative analysis of seaweed metabolism) in cooperation with SBR Roscoff. Major objectives are the building of brown algae metabolic maps, flux analysis and the selection extraction of important parameters for the production of targeted compounds. We will also contribute to the prediction of specific enzymes (sulfatases) within workpackage 5 .[details]

7.2.2. *Methodology: ANR Biotempo*

Participants: Anne Siegel, Jérémie Bourdon, François Coste, Damien Eveillard, Jacques Nicolas, Michel Le Borgne, Geoffroy Andrieux, Andres Aravena, Vincent Picard, Sylvain Prigent, Santiago Videla.

The BioTempo projects aims at developing some original methods for studying biological systems. The goal is to introduce partial quantitative information either on time or on component observations to gain in the analysis and interpretation of biological data. Three biological applications are considered regulation systems used by biomining bacteria, TGF-$beta$ signaling and initiation of sea-urchin translation. It is funded by ANR Blanc (SIMI2) and coordinated by A. Siegel from 2011 to 2014. Teams involved include LINA (Nantes), I3S (Nice), DIMPP (Montpellier), Contrainte project team (Inria), IRSET (Rennes) and Station biologique de Roscoff [details]

7.2.3. *Proof-of-concept on dedicated applications*

7.2.3.1. ANR Fatinteger

Participants: Aymeric Antoine-Lorquin, Catherine Belleannée, Jacques Nicolas, Olivier Quenez, Anne Siegel.

This project (ANR Blanc SVE7 "biodiversité, évolution, écologie et agronomie" from 2012 to 2015) is leaded by INRA UMR1348 PEGASE (F. Gondret). Its goal is the identification of key regulators of fatty acid plasticity in two lines of pigs and chickens. To reach these objectives, this project has for ambition to test some combination of statistics, bioinformatics and phylogenetics approaches to better analyze transcriptional data of high dimension. Data and methods integration is a key issue in this context. We work on the recognition of specific common cis-regulatory elements in a set of differentially expressed genes and on the regulation network associated to fatty acid metabolism with the aim of extracting some key regulators.

7.2.3.2. ANR Lepidolf

Participants: François Coste, Jacques Nicolas.

The LEPIDOLF project aims at better understanding olfactory mechanisms in insects. The goal is to establish the antennal transcriptome of the cotton leafworm Spodoptera littoralis, a noctuid representative of crop pest insects. It is funded by ANR call Blanc and coordinated by E. Jacquin-Joly from UMR PISC (INRA Versailles) from 2009 to 2013. Our contribution is to use grammatical inference to build characteristic signatures of the Olfactory Receptor family, which will be used to scan directly 454-sequencing reads and available partial cDNAs of genes expressed in the antenna of Lepidoptera or deduced proteins.

7.2.3.3. ANR Mirnadapt
Participants: Jacques Nicolas, Catherine Belleannée, Anne Siegel, Valentin Wucher.

This ANR project is coordinated by UMR IGEPP, INRA Le Rheu (D. Tagu) and funded by ANR SVSE 6 "Génomique, génétique, bioinformatique, biologie systémique" from 2012 to 2014. This cooperation is strengthened by a co-tutored PhD thesis (V. Wucher). It proposes an integrative study between bioinformatics, genomics and mathematical modeling focused on the transcriptional basis of the plasticity of the aphid reproduction mode in response to the modification of environment. An important set of differentially expressed mRNAs and microRNAs are available for the two modes, asexual parthenogenesis and sexual reproduction. Our work is to combine prediction methods for the detection of putative microRNA/mRNA interactions as well as transcription factor binding sites from the knowledge of genomic sequences and annotations available on this and other insects. The results will be integrated within a coherent putative interaction network and serve as a filter for the design of new targeted experiments with the hope to improve functional annotations of implied genes.

7.2.3.4. ANR Pelican
Participant: François Coste.

The PELICAN project addresses competition for light in the ocean. It proposes an integrative genomic approach of the ecology, diversity and evolution of cyanobacterial pigment types in the marine environment, which arises from differences in the composition of the light-harvesting complexes (PBS). Our work is to build characteristic signatures of targeted PBS enzymes. This ANR project (génomique et biotechnologies végétales) is coordinated by F. Partensky (CRNS Roscoff) from 2010 to 2013.

7.2.4. Programs funded by research institutions

7.2.4.1. Inria Bioscience Ressource
Participants: Claudia Hériveau, Jacques Nicolas.

This project started in november 2011 and aims at promoting bioinformatics software and resources developed by Inria teams and their partners. A web portal will be deployed to allow users to test the software online. A tool is also developed to enhance the search of a specific resource using different criteria. The project is funded by Inria ADT program from 2011 to 2013, involves 8 research teams and is coordinated by the GenOuest platform and the Dyliss team (J. Nicolas and O. Collin).

7.2.4.2. PEPS VAG
Participants: François Coste, Jacques Nicolas, Clovis Galiez.

PEPS VAG started a collaboration between IMPMC UMR 7590, Institut de biologie de l'Ecole Normale Supérieure (IBENS) UMR8197, Atelier de Bioinformatique UPMC and Dyliss. It aims at defining the needs and means for a larger project about viruses in marine ecosystems. Indeed, we aim at developing new methods based on both sequential and structural information of proteins to improve the detection of viral sequences in marine metagenomes, to identify new viruses and to compare the viral populations specifically associated with different environment parameters (temperature, acidity, nutriments...) and ultimately to connect them with the potential hosts identified by population sequencing.

7.3. European Initiatives

7.3.1. Collaborations with Major European Organizations

Partner: EBI (Great-Britain)

Title: Modeling the logical response of a signalling network with constraints-programming.

Partner: Potsdam university (Germany)

Title: Constraint-based programming for the modelling and study of biological networks.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. INTEGRATIVEBIOCHILE

Title: Bioinformatics and mathematical methods for heterogeneous omics data

Inria principal investigator: Anne Siegel

International Partner (Institution - Laboratory - Researcher):

University of Chile (Chile) - Center for Mathematical Modeling - Alejandro Maass

Duration: 2011 - 2013

See also: http://www.irisa.fr/dyliss/public/EA/index.html

IntegrativeBioChile is an Associate Team between Inria project-team "Dyliss" and the "Laboratory of Bioinformatics and Mathematics of the Genome" hosted at CMM at University of Chile. The Associated team is funded from 2011 to 2013. The project aims at developing bioinformatics and mathematical methods for heterogeneous omics data. Within this program, we funded long and short stay visitings in France.

7.4.2. Inria International Labs

The Dyliss team is strongly involved in the Inria CIRIC center, and the research line "Omics integrative center": the associated team "IntegrativeBioChile", the post-doc of S. Thiele and the co-supervised of A. Aravena contribute to reinforce the complementarity of both Chilean and French teams. In 2013, a workshop was organized in Chile to develop new French-Chilean collaboration within the framework of the CIRIC center. See Sec. 7.2.1 for details.

7.4.3. Participation In other International Programs

7.4.3.1. Argentina - MinCYT-Inria 2011-13

Partner: Universidad Nacional de Cordoba, *Grupo de Procesamiento de Lenguaje Natural (PLN)*, Argentina.

Title: Modélisation linguistique de séquences génomiques par apprentissage de grammaires

Financial support: MinCYT-Inria program 2011-13

The projects aims at developing new grammatical inference methods to learn automatically linguistic models of genomic sequences.

7.4.3.2. International joint supervision of PhD

Title: Introduction des approches combinatoires dans des modèles probabilistes pour la découverte d'évènements de régulation d'un système biologique à partir de données hétérogènes [*A. Aravena*]

Inira principal investigator: Anne Siegel

International Partners (Institution - Laboratory - Researcher):

University of Chile (Chile) - Center of Mathematical Modelling - Alejandro Maass

Duration: Jul 2011 - Dec 2013

Title: Analyse automatisée et générique de réseaux métaboliques en nutrition [*O. Abdou-Arbi*]

Inria principal investigator: Anne Siegel

International Partner (Institution - Laboratory - Researcher):

University of Ouagadougou (Burkina Faso) - Department of mathematics - T. Tabsoba.

Duration: October 2010 - September 2013

Title: Applying logic programming to the construction of robust predictive and multi-scale models of bioleaching bacteria [*S. Videla*]

Inria principal investigator: Anne Siegel

International Partner (Institution - Laboratory - Researcher):

University of Postdam (Germany). Department of computer science. T. Schaub.

Duration: October 2011 - September 2014

7.5. International Research Visitors

7.5.1. Visits of International Scientists

- **Germany**. Department of Computer Science, Potsdam [T. Schaub]
- **Chile**. Centro de Modelimiento Matematico, Santiago [A. Maass, N. Loirà]
- **Burkina-Faso**. Laboratoire de mathématiques, Ouagadougou [T. Tabsoba]

7.5.1.1. Internships

Andres Aravena

Subject: Programmation par Ensemble-Réponse pour l'identification de régulateur clés en biologie des systèmes

Date: from Jan 2013 until Jul 2013

Institution: University of Chile (Chile)

7.5.2. Visits to International Teams

- **Burkina-Faso**. Department of Computer Science, Ouagadougou. *Multi-objective methods for the static analysis of metabolic network*. Jan. 2013 (1 month) [O. Abdou-Arbi]
- **Niger**. University of Maradi. *Multi-objective methods for the static analysis of metabolic network*. Feb. 2013 (1 month) [O. Abdou-Arbi]
- **UK** EMBL-European Bioinformatics Institute. *Learning logical rules for protein signaling networks*. Feb. 2013 (2 days) [A. Siegel, S. Thiele, S. Videla]
- **UK** Brunel University *Learning logical rules for protein signaling networks*. Feb. 2013 (3 days) [A. Siegel, S. Thiele, S. Videla]
- **Germany**. Max Planck Institute (Klamt lab), Magdeburg. *Application of ASP to the control of signaling networks*. June 2013 (2 days) [S Thiele, S. Videla]
- **Argentina**. Departamento Universitario de Informática, Cordoba. *Collaboration on grammatical inference*. Jul. 2013 (14 days) [F. Coste]

- **Argentina**. Departamento Universitario de Informática, Cordoba. *Collaboration on grammatical inference*. Jul. 2013 (1 month) [G. Garet]

- **Germany**. Department of Computer Science, Potsdam. *Application of ASP to biology, meeting with Klamt and Schaub labs*. Oct 2013 (3 days) [A. Siegel, S. Videla]

- **Germany**. Department of Computer Science, Potsdam. *Application of ASP for sequence annotation*. Oct. Nov. Dec. 2013 (3 months) [G. Garet]

- **Chile**. Centro de Modelimiento Matematico, Santiago. *Applications of ASP*. Nov. & Dec 2013 (2 monthes) [S. Videla]

- **Chile**. Centro de Modelimiento Matematico, Santiago. *Metabolic modeling of bacteria*. Dec. 2013 (14 days) [D. Eveillard]

- **Chile**. Centro de Modelimiento Matematico, Santiago. *Data integration*. Dec. 2013 (7 days) [A. Siegel, S. Prigent, J. Laniau, V. Picard, F. Coste]

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

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

Program: ANR

Project acronym: VeriSync

Project title: Vérification formelle d'un générateur de code pour un langage synchrone

Duration: Nov. 2010 - Oct. 2013

Coordinator: IRIT

Other partners: IRIT

URL: http://www.irit.fr/Verisync/

Abstract:

The VeriSync project aims at improving the safety and reliability assessment of code produced for embedded software using synchronous programming environments developed under the paradigm of Model Driven Engineering. This is achieved by formally proving the correctness of essential transformations that a source model undergoes during its compilation into executable code.

Our contribution to VeriSync consists of revisiting the seminal work of Pnueli et al. on translation validation and equip the Polychrony environment with updated verification techniques to scale it to possibly large, sequential or distributed, C programs generated from the Signal compiler. Our study covers the definition of simulation and bisimulation equivalence relations capable of assessing the correspondence between a source Signal specification and the sequential or concurrent code generated from it, as well as both specific abstract model-checking techniques allowing to accelerate verification and counter-example search techniques, to filter spurious verification failures obtained from excessive abstracted exploration.

7.1.2. Competitivity Clusters

Program: FUI

Project acronym: P

Project title: Project P

Duration: March 2011 - Sept. 2015

Coordinator: Continental Automotive France

Other partners: 19 partners (Airbus, Astrium, Rockwell Collins, Safran, Thales Alenia Space, Thales Avionics...)

URL: http://www.open-do.org/projects/p/

Abstract:

The aim of project P is 1/ to aid industrials to deploy model-driven engineering technology for the development of safety-critical embedded applications, 2/ to contribute on initiatives such as OPEES [23] and CESAR [22] to develop support for tools inter-operability, and 3/ to provide state-of-the-art automated code generation techniques from multiple, heterogeneous, system-levels models. The focus of project P is the development of a code generation toolchain starting from domain-specific modeling languages for embedded software design and to deliver the outcome of this development

as an open-source distribution, in the aim of gaining an impact similar to GCC for general-purpose programming, as well as a kit to aid with the qualification of that code generation toolchain.

The contribution of project-team ESPRESSO in project P is to bring the necessary open-source technology of the Polychrony environment to allow for the synthesis of symbolic schedulers for software architectures modeled with P in a manner ensuring global asynchronous deterministic execution..

7.1.3. CORAC

Program: CORAC

Project acronym: CORAIL

Project title: Composants pour l'Avionique Modulaire Étendue

Duration: July 2013 - May 2017

Coordinator: Thales Avionics

Other partners: Airbus, Dassault Aviation, Eurocopter, Sagem...

URL: http://www.corac-ame.com/

Abstract:

The CORAIL project aims at defining components for Extended Modular Avionics. The contribution of project-team ESPRESSO is to define a specification method and to provide a generator of multi-task applications.

7.2. International Initiatives

7.2.1. Inria Associate Teams

7.2.1.1. POLYCORE

Title: Models of computation for embedded software design of multi-core architectures

Inria principal investigator: Jean-Pierre Talpin

International Partner :

Virginia Tech Research Laboratories, Arlington (United States)

Embedded Systems Group, Teschnische Universität Kaiserslautern (Germany)

Duration: 2011 - 2013

See also: http://www.irisa.fr/espresso/Polycore

Anyone experienced with multi-threaded programming would recognize the difficulty of designing and implementing such software. Resolving concurrency, synchronization, and coordination issues, and tackling the non-determinism germane in multi-threaded software is extremely difficult. Ensuring correctness with respect to the specification and deterministic behavior is necessary for safe execution of such code. It is therefore desirable to synthesize multi-threaded code from formal specifications using a provably "correct-by-construction" approach. In Europe, it has been widely claimed that the embedded software for "fly-by-wire" was mostly automatically generated using French tools based on the synchronous programming models. Unfortunately, software generated in those contexts usually operate in a time-triggered execution model. Such models are simpler but less efficient than multi-threaded software on multi-core processors. Normally they run on multiple processors communicating over a time-triggered bus. Hence the execution is less efficient than it could be. While time-triggered programming model simplifies code generation, we feel that multi-rate event driven execution model is much more efficient. Code synthesis for such execution model must be thoroughly investigated. The multi-threaded software generation is inspired by a recent shift in the hardware design paradigms from single-core to multi-core processors. This shift has brought parallel and concurrent programming to the desktop and embedded arena. In the desktop market, most processors

now being sold are multi-core, and very soon this trend might conquer the embedded world as well. We plan to develop formal models, methods, algorithms and techniques for generating provably correct multi-threaded reactive real-time embedded software for mission-critical applications. For scalable modeling of larger embedded software systems, the specification formalism has to be compositional and hierarchical. Our proposed formalism entails a model of computation (MoC) based on a multi-rate synchronous dataflow paradigm: Polychrony.

7.2.2. Inria International Partners

7.2.2.1. The University of Hong Kong, Emerging Technologies Institute

Title: Virtual prototyping of embedded software architectures

Inria principal investigator: Jean-Pierre Talpin

International Partner :

The University of Hong Kong - Emerging Technologies Institute - John Koo

Embedded software architectures are modeling objects at the crossing of several design viewpoints: the physical environment, the embedded software and the hardware architecture. These viewpoints present different perceptions of time: continuous and discrete, event-based and clock-based. They are further represented by high-level models that significantly alter this perception: in the model of the environment, evolution over time is represented by differential equations whose resolution alters discrete simulation time; in the model of the embedded software, hardware/operating-system events are sampled by periodic reaction loops; in the model of the hardware, instruction clock time is usually approximated by coarser periods or transactions. Providing a mathematical framework, verification and synthesis tools, to understand, compose and orchestrate them would prove invaluable to system architects. The architect operates from design focus point around which all components of the system under design—software, middleware, hardware and environment—need to be analyzed, profiled, composed, simulated, validated. It is the aim of our project to propose a formal design methodology to that purpose.

7.2.2.2. Beihang University, Institute of Computer Architectures

Title: Certifiable development of a synchronous compiler for multi-core platforms

Inria principal investigator: Jean-Pierre Talpin

International Partner :

Beihang University, China - Institute of Computer Architectures - Kai Hu

The synchronous paradigm is a widely accepted approach for the design of safety-critical applications, such as digital circuits or embedded software. The well-defined notions of time and causality at specification-level provide a simple way to model, analyze and verify systems. The synchronous programming paradigm is made popular because of its role at the joint point of 1) computer science and language design, 2) control theory and reactive systems, and 3) microelectronic (synchronous) circuit design. It provides a sound semantic background with a notion of discrete instants and successive reactions, together with high-level structuring primitives which help defining subthreads whose activations (defined by signals or clocks) model over/sub-sampling. Exploiting the semantic independence of various computations to allow the generation of concurrent, potentially distributed code from synchronous and polychronous specifications is a notoriously difficult subject. It amounts to determining which part of the system-wide synchronization specific to the synchronous model can be removed while preserving the specified functionality. In this context, the objective of the proposed project consists in the design of a certifiable compiler from a synchronous language to a multicore platform. However, even if the compilation of endochronous systems to a sequential architecture has been widely studied for twenty years, targeting multicore architectures is more recent and exploiting weak endochrony has not yet been deeply explored. Three main points will be addressed: the architecture of a compiler of weakly-endochronous programs to a virtual parallel machine; the formal verification of some of these compilation steps as well as the formal modeling of the target; the study of multicore platforms, of their synchronization primitives and the implementation of the virtual machine on such a platform.

7.2.3. Participation In other International Programs

7.2.3.1. USAF Office for Scientific Grant FA8655-13-1-3049

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

Inria principal investigator: Jean-Pierre Talpin

International Partner :

Virginia Tech Research Laboratories, Arlington (United States)

Embedded Systems Group, Teschnische Universität Kaiserslautern (Germany)

Duration: 2013 - 2016

See also: http://www.irisa.fr/espresso/Polycore

The aim of the USAF OSR Grant FA8655-13-1-3049 is to support collaborative research entitled "Co-Modeling of safety-critical multi-threaded embedded software for multi-core embedded platforms" between Inria project-team ESPRESSO, the VTRL Fermat Laboratory and the TUKL embedded system research group, under the program of the Polycore associate-project.

7.3. International Research Visitors

7.3.1. Visits to International Teams

- Jean-Pierre Talpin was awarded a visiting researcher grant by the Chinese Academy of Science. In this context, he visited the Shenzhen Institutes of Advanced Technology and the University of Hong Kong in January, July and August, and Beihang University in November and December.

- In the context of the associate project Polycore, Jean-Pierre Talpin visited Virginia Tech Research Laboratories, Arlington, in April and October.

FLUMINANCE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. *Britanny concil ARED IMAGEO:*
Participants: Cédric Herzet, Etienne Mémin, Véronique Souchaud.

duration 36 months. This project of the Britanny concil, which finances the PhD thesis of Véronique Souchaud, aims at studying methods for the estimation of reduced order modeling of fluid flows evolution laws from image sequences. The goal consists here at defining the estimation of a reduced basis describing the flow evolution as a motion estimation problem.

8.2. National Initiatives

8.2.1. *ANR-COSINUS PREVASSEMBLE: Ensemble methods for assimilation of observaions and for prevision in Meteorology and Oceanography*
Participants: Sébastien Beyou, Anne Cuzol, Etienne Mémin.

duration 36 months.

The purpose of this project is to further study ensemble methods -, and to develop their use for both assimilation of observations and forecast. Among the specific questions to be studied are the theory of Particle Filters and Ensemble Kalman Filters, the possibility of taking temporal correlation into account in ensemble assimilation, the precise assessment of what can and cannot be achieved in ensemble prediction, and the objective validation of ensemble methods.

The partners of this project are Laboratoire de Météorologie Dynamique/ENS (leader), Météo-France and three Inria groups (ALEA, ASPI, FLUMINANCE).

8.2.2. *ANR SYSCOMM MSDAG: MultiScale Data Assimilation in Geophysics*
Participants: Patrick Héas, Dominique Heitz, Cédric Herzet, Etienne Mémin.

duration 36 months.

Changing scale is a well-known topic in physics (geophysics, fluid mechanics and turbulence, theoretical and statistical physics, mechanics, porous media, etc.). It has led to the creation of powerful sophisticated mathematical tools: renormalization, homogenization, etc. These ideas are also used in numerical analysis (the so-called multigrid approach) for solving efficiently partial differential equations. Data assimilation in Geophysics is a set of methods that allows to combine optimally numerical models in large spaces with large dataset of observations. At the confluence of these two topics, the goal of this project is to study how to embed the change of scales (a multiscale point of view) issue into the framework of geophysical data assimilation, which is a largely unexplored subject.

The partners of this 3 years project are the CEREA/ CLIME Inria group (leader), the LSCE/CEA, the Inria groups MOISE and FLUMINANCE.

8.2.3. *ANR SYSCOMM GeoFluids: Analyse et simulation d'écoulements fluides à partir de séquences d'images : application à l'étude d'écoulements géophysiques*
Participants: Dominique Heitz, Etienne Mémin.

duration 48 months.

The project Geo-FLUIDS focuses on the specification of tools to analyze geophysical fluid flows from image sequences. Geo-FLUIDS aims at providing image-based methods using physically consistent models to extract meaningful features describing the observed flow and to unveil the dynamical properties of this flow. The main targeted application domains concern Oceanography and Meteorology . The project consortium gathers the Inria research groups: FLUMINANCE (leader), CLIME and MOISE. The group of the "Laboratoire de Météorologie Dynamique" located at the ENS Paris, the IFREMER-CERSAT group located at Brest and the METEOFRANCE GMAP group in Toulouse.

8.2.4. *ANR JCJC GERONIMO : Advanced GEophysical Reduced-Order Model construction from IMage Observations*
Participant: Cédric Herzet.

duration 48 months. The GERONIMO project which starts in January 20014 aims at devising new efficient and effective techniques for the design of geophysical reduced-order models from image data. The project both arises from the crucial need of accurate low-order descriptions of highly-complex geophysical phenomena and the recent numerical revolution which has supplied the geophysical scientists with an unprecedented volume of image data. The project is placed in the intersection of several fields of expertise (Bayesian inference, matrix factorization, sparse representations, etc) which will be combined to handle the uncertainties associated to image measurements and to characterize the accurate reduced dynamical systems.

8.2.5. *INSU-LEFE: Vers de nouvelles méthodes d'estimation de la sous-mésoéchelle océanique*
Participants: Patrick Héas, Cédric Herzet.

duration 36 months. This project tackles the problem of deriving a precise submesoscale characterization of ocean currents from satellite data. The targeted methodologies should in particular enable the exploitation of data of different nature (for example sea surface temperature or height) and/or resolutions. This 36-month project benefits from a strong collaboration with Guillaume Lapeyre (Laboratoire de Météorologie Dynamique, Ecole Normale Supérieure, Paris).

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Program from Région Bretagne : MIRAGE

Participants: Liviu Ciortuz, Claire Lemaitre, Pierre Peterlongo.

The MIRAGE project is funded by Région Bretagne in the framework of the SAD call (Stratégie Attractivité Durable) which aims at attracting international post-doctorant for one year. The MIRAGE project was funded from Sept. 2012 until August 2013 and coordinated by C. Lemaitre. It enabled to hire Liviu Ciortuz as a postdoctoral student for 12 months, for developping new methods to detect complex variation (structural variations) in non-assembled NGS data.

8.1.2. Program from Région Bretagne : DGASP

Participants: Antonio Mucherino, Douglas Goncalves.

This project is funded by Région Bretagne in the framework of the SAD call (Stratégie Attractivité Durable), from April 2013 to March 2014 and coordinated by A. Mucherino. It enabled to hire Douglas Goncalves as a postdoctoral student for 12 months for working on a discretizable class of distance geometry problems. The project is in collaboration with Carlile Lavor (IMECC-UNICAMP, Brazil) and Jacques Nicolas (équipe Dyliss, IRISA).

8.1.3. Poly-BNF

Participants: Dominique Lavenier, Claire Lemaitre, Pierre Peterlongo, Erwann Scaon.

This projects aims to develop bioinformatics strategies for studying polyploid genomes. It is a one year project (09/2012 – 09/2013) funded by the University of Rennes 1. It is a joined project with CNRS/EcoBio lab and INRA/IGEPP lab in Rennes.

8.1.4. Partnership with IGDR

Participants: Dominique Lavenier, Claire Lemaitre, Pierre Peterlongo, Guillaume Rizk, Fabrice Legeai, Charles Deltel.

We collaborate with several teams of the Genomic and Development Institute of Rennes (IGDR) : Genetics of dog (detection of long non coding RNAs in collaboration with Thomas Derrien and Christophe Hitte) and Integrated Fonctional Genomics and Biomarkers (NGS analyses of glioblastoma cancer, project funded by INCa in collaboration with Marie de Tayrac and Jean Mosser).

8.1.5. Partnership with INRA

Participants: Dominique Lavenier, Claire Lemaitre, Pierre Peterlongo, Guillaume Rizk, Anaïs Gouin, Fabrice Legeai, François Moreews, Susete Alves Carvalho.

We have a strong and long term collaboration with biologists of INRA in Rennes : IGEPP and PEGASE units. This partnership concerns both service and research activities and is acted by the hosting of two ingineers (F. Legeai, F. Moreews) and by the co-supervision of two non permanent engineers (A. Gouin, S. Alves Carvalho). In particular, the collaboration with the IGEPP team includes several research projects in which Genscale is formally a partner : an INRA project PEAPOL including an industrial partner, Biogemma, and an ANR project SPECIAPHID. These projects fund the non-permanent INRA members.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. MAPPI

Participants: Dominique Lavenier, Claire Lemaitre, Nicolas Maillet, Pierre Peterlongo.

The MAPPI project aims to develop new algorithms and Bioinformatics methods for processing high trougthput genomic data. It is funded by ANR call COSINUS and coordinated by M. Raffinot (LIAFA, Paris VII) from Oct 2010 to Dec. 2013.

8.2.1.2. FATINTEGER

Participants: Dominique Lavenier, François Moreews.

The FatInteger project aims to identify some of the transcriptional key players of animal lipid metabolism plasticity, combining high throughput data with statistical approaches, bioinformatics and phylogenetic. It is funded by ANR call BLANC and coordinated by F. Gondret from 2012 to 2015.

8.2.1.3. SPECIAPHID

Participants: Anaïs Gouin, Fabrice Legeai, Claire Lemaitre.

The SPECIAPHID project aims to understand the adaptation and speciation of pea aphids by re-sequencing and comparing the genomes of numerous aphid individuals. Genscale's task, as associate partner, is to apply and develop new methods to detect variation between re-sequenced genomes, and in particular complex variants such as structural ones. It is funded by ANR call BLANC and coordinated by J-C Simon (Inra, Rennes) from January 2012 to Dec. 2014.

8.2.1.4. ADA-SPODO

Participants: Rumen Andonov, Dominique Lavenier, Fabrice Legeai, Claire Lemaitre, François Moreews, Pierre Peterlongo.

The ADA-SPODO project aims at identifying all sources of genetic variation between two strains of an insect pest : Lepidoptera Spodoptera frugiperda in order to correlate them with host-plant adaptation and speciation. Genscale's task is to develop new efficient methods to compare complete genomes along with their postgenomic and regulatory data. It is funded by ANR call BLANC and coordinated by E. d'Alençon (Inra, Montpellier) from October 2012 to Dec. 2015.

8.2.1.5. RAPSODYN

Participants: Dominique Lavenier, Claire Lemaitre, Pierre Peterlongo, Erwann Scaon.

RAPSODYN is a long term project funded by the IA French program (Investissement d'Avenir) for 7.5 years (07/2012-12/2019). The objective is the optimisation of the rapeseed oil content and yield under low nitrogen input. GenScale is involved in the bioinformatics workpackage to elaborate advanced tools dedicated to polymorphism.

8.2.1.6. COLIB'READ

Participants: Pierre Peterlongo, Claire Lemaitre, Dominique Lavenier, Fabrice Legeai, Guillaume Rizk.

The main goal of the Colib'Read project is to design new algorithms dedicated to the extraction of biological knowledge from raw data produced by High Throughput Sequencers (HTS). The project proposes an original way of extracting information from such data. Usually, a generic assembly (pre-treatment) is applied to the data, and then, in a second step, any information of interest is extracted. Our aim is to avoid this protocol that leads to a significant loss of information, or generates chimerical results because of the heuristics used in the assembly. Instead, the project will propose a set of innovative approaches for extracting information of biological interest from HTS data, with methods that bypass any costly and often inaccurate assembly phase, not requiring the availability of a reference genome. It is funded by ANR call BLANC and coordinated by P. Peterlongo from March 2013 to February 2016. https://colibread.inria.fr/

8.2.1.7. GATB

Participants: Dominique Lavenier, Erwan Drezen, Pierre Peterlongo, Claire Lemaitre, Guillaume Rizk.

GATB (Genome Assembly Tool Box) is a project that aims to provide algorithms and tools for genome assembly. The strength of these algorithms comes from the underlying structure that has a low memory footprint, which enables to assemble genomes on a simple desktop computer. The GATB project will provide several software components, such as low level libraries, binaries and pipelines providing a full spectrum of tools for genome assembly. It is a 2 years ANR project started in February 2013. http://gatb.inria.fr

8.2.2. Programs from research institutions

8.2.2.1. Mapsembler

Participants: Alexan Andrieux, Dominique Lavenier, Claire Lemaitre, Pierre Peterlongo.

The Mapsembler project aims at finalizing and to distributing the Mapsembler tool. It is funded by Inria ADT call (2012) and coordinated by P. Peterlongo from oct. 2012 to sept. 2014. http://alcovna.genouest.org/mapsembler/

8.2.2.2. Mastodons

Participants: Dominique Lavenier, Claire Lemaitre, Pierre Peterlongo.

This project, funded by the CNRS Big Data program in 2012 and 2013, aims do investigate the challenge brought by the processing of high throughput sequencing genomic data. It is coordinated by D. Lavenier from June 2012 to December 2013.

8.2.2.3. Barcoding de nouvelle génération

Participants: Dominique Lavenier, Claire Lemaitre, Pierre Peterlongo.

This project is a join initiative between Genscale and LECA (Laboratoire d'Ecologie Alpine in Grenoble). It aims at developping new algorithmic approaches for the species identification from low coverage NGS data. It is funded by a PEPS program at CNRS/Inria and coordinated by C. Lemaitre from Sept. 2012 to Dec. 2013.

8.2.2.4. Structuring of NGS for diagnostic purpose in cancer

Participants: Dominique Lavenier, Claire Lemaitre, Pierre Peterlongo.

This 18 months project is funded by the national institute of cancer (INCa). Genscale is involved in the optimization of bioinformatics workflows to detect variants in glioblastoma cancer.

8.2.3. Cooperations

8.2.3.1. Inria Bamboo Team

Participants: Claire Lemaitre, Pierre Peterlongo.

We maintain a long term collaboration with Inria Bamboo Team on the problems of finding biological information, such as variants, in NGS raw data.

8.2.3.2. LIGM, Paris

Participant: Pierre Peterlongo.

P. Peterlongo collaborates with the LIGM lab in Paris (UMR 8049), on problems of large NGS raw data indexation.

8.2.3.3. LIX

Participant: Antonio Mucherino.

A. Mucherino collaborates since 5 years with LIX, Ecole Polytechnique, in Palaiseau on the distance geometry problem. We reformulated the problem as a combinatorial optimization problem and we conceived an ad-hoc algorithm for the solution of this class of problems.

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations

Partner: CWI, University of Amsterdam, (Netherland)

Subject of cooperation: Optimization algorithms for protein structures alignments.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal International Partners

Partner: IMECC, UNICAMP, Campinas-SP (Brazil)

Subject: distance geometry, bioinformatics.

Partner:COPPE, Federal University of Rio de Janeiro (Brazil)

Subject: distance geometry, bioinformatics.

Partner: Los Alamos National Laboratory (lanl), Los Alamos (USA)

Subjects: Combinatorial algorithms (shortest paths, graph partitioning, combinatorial optimization) and algorithm engineering (efficient implementation of combinatorial algorithms)

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Van-Hoa Nguyen from University of Angiang, Viet Nam, visited GenScale for 3 months (nov. 2012 - feb. 2013). The visit was funded by the French Mastodons program from CNRS to research focusing on bioinformatics big data problem.
- Fatima Sapundzhi and Boyana Garkova, PhD students from South-West University, Neofit Rilski, Blagoevgrad (Bulgaria), visited the team for one month in October 2013. The visit was funded by the bulgarian ministery and focused on ligand-protein interaction structure problems in collaboration with R. Andonov and M. Le Boudic-Jamin.

8.5.2. Visits to International Teams

- R. Andonov has been invited by the Information Sciences Group (CCS-3) from Los Alamos National Laboratory (LANL) for one month (15 July - 15 August 2013).

HYBRID Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. BRAINVOX Project

Participants: Anatole Lécuyer [contact], Jozef Legény.

BRAINVOX is a project funded by Brittany region in the frame of the CREATE call. It is a 4-year project (2009-2013) on the topic of Brain-Computer Interfaces. The objective is to reach a "mental vocabulary", more elaborated, and richer, for BCI applications, enabling to exploit various mental activities within novel hybrid schemes.

8.1.2. W3D Project

Participants: Ferran Argelaguet Sanz, Anatole Lécuyer [contact], Maud Marchal.

W3D is a project funded by Brittany region and "Images et Réseaux" competitivity cluster. It is a 3-year project (2011-2013) dedicated to the improvement of perception and navigation on 3D Web content. It involves Inria/Hybrid and LOUSTIC lab, and two SMEs in the field of multimedia and web applications : MBA Multimédia and Polymorph Studio.

8.1.3. CNPAO Project

Participant: Valérie Gouranton [contact].

CNPAO ("Conservatoire Numérique du Patrimoine Archéologique de l'Ouest") is a research project partially funded by the Université Européenne de Bretagne (UEB). It involves IRISA/Hybrid and CReAAH. The main objectives are: (i) a sustainable and centralized archiving of 2D/3D data produced by the archaeological community, (ii) a free access to metadata, (iii) a secure access to data for the different actors involved in scientific projects, and (iv) the support and advice for these actors in the 3D data production and exploration through the latest digital technologies, modeling tools and virtual reality systems.

8.1.4. Labex S3PM

Participants: Bruno Arnaldi [contact], Valérie Gouranton [contact], Guillaume Claude.

S3PM is a 3-year project (2013-2016) funded by Labex CominLabs. It involves 3 academic research teams: Medicis (LTSI/Inserm), S4 and Hybrid (IRISA/Inria). S3PM aims at providing specific models, tools and software to create a collaborative virtual environment dedicated to neurosurgery processes using observations of real processes.

8.1.5. Labex HEMISFER

Participant: Anatole Lécuyer [contact].

HEMISFER is a 3-year project (2013-2016) funded by Labex CominLabs. It involves 4 Inria/IRISA teams (Hybrid, Visages (lead), Panama, Athena) and 2 medical centers: the Rennes Psychiatric Hospital (CHGR) and the Reeducation Department of Rennes Hospital (CHU Pontchaillou). The goal of HEMISFER is to make full use of neurofeedback paradigm in the context of rehabilitation and psychiatric disorders. The major breakthrough will come from the use of a coupling model associating functional and metabolic information from Magnetic Resonance Imaging (fMRI) to Electro-encephalography (EEG) to "enhance" the neurofeedback protocol. Clinical applications concern motor, neurological and psychiatric disorders (stroke, attention-deficit disorder, treatment-resistant mood disorders, etc).

8.2. National Initiatives

8.2.1. ANR CORVETTE

Participants: Bruno Arnaldi [contact], Valérie Gouranton [contact], Florian Nouviale, Thomas Lopez, Rozenn Bouville Berthelot, Thomas Boggini, Quentin Petit.

CORVETTE (COllaboRative Virtual Environment Technical Training and Experiment) is a 4-year ANR project (2011-2014) led by Bruno Arnaldi. It involves 3 Academic partners (INSA Rennes, ENIB, CEA-List) and 4 Industrial partners (AFPA, Nexter Training, Virtualys, Golaem). CORVETTE aims at designing novel approaches for industrial training (maintenance, complex procedures, security, diagnosis, etc) exploiting virtual reality technologies. The project has three main research axes: collaborative work, virtual human, communication and evaluation. The project seeks to put in synergy: 1) Virtual Human for its ability to embody the user as an avatar and acting as a collaborator during trainingj; 2) Natural communication between users and virtual humans for task-oriented dialogues; and 3) Methodologies in cognitive psychology for the assessment of the effectiveness of the collaboration of users and virtual humans to perform complex cooperative tasks in VR. All these components have been integrated into a unified environment based on an industrial scenario. Several evaluations regarding the different technologies developed in the project have also been achieved.
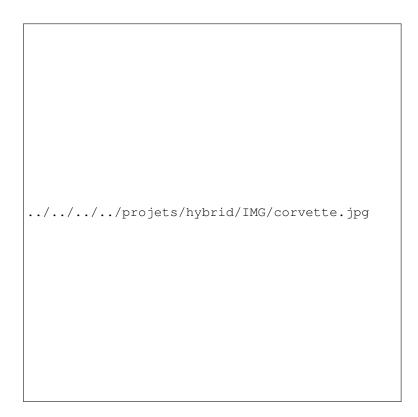

../../../../projets/hybrid/IMG/corvette.jpg

Figure 10. Exhibition of the CORVETTE project at Laval Virtual 2013.

8.2.2. ANR MANDARIN

Participants: Merwan Achibet, Anatole Lécuyer, Maud Marchal [contact].

MANDARIN ("MANipulation Dextre hAptique pour opéRations INdustrielles en RV") is a 4-year ANR project (2012-2015). MANDARIN partners are CEA-List (coordinator), Inria/Hybrid, UTC, Haption and Renault. It aims at designing new hardware and software solutions to achieve natural and intuitive mono and bi-manual dextrous interactions, suitable for virtual environments. The objective of Hybrid in MANDARIN is to design novel multimodal 3D interaction techniques and metaphors allowing to deal with haptic gloves limitations (portability, under-actuation) and to assist the user in virtual reality applications requiring dexterous manipulation. The results will be evaluated with a representative industrial application which is not feasible with currently existing technologies: the bi-manual manipulation of complex rigid objects and cables bundles.

8.2.3. *ANR HOMO-TEXTILUS*

Participants: Anatole Lécuyer [contact], Maud Marchal, Jonathan Mercier-Ganady.

HOMO-TEXTILUS is a 4-year ANR project (2012-2015). Partners of the project are : Inria/Hybrid, CHART, LIP6, TOMORROW LAND, RCP and potential end-user is Hussein Chalayan fashion designer. The objective of HOMO TEXTILUS is to study what could be the next generation of smart and augmented clothes, and their influence and potential impact on behavior and habits of their users. The project is strongly oriented towards human science, with both user studies and sociological studies. The involvement of Hybrid team in the project consists in studying the design of next-gen prototypes of clothes embedding novel kinds of sensors and actuators. Envisionned sensors relate to physiological measurements such as with EEG (electroencephalograpohy and Brain-Computer Interfaces), EMG (muscular activity), GSR (galvanic skin response) or Heart Rate (HR). Envisionned actuators relate to new sensory stimulations such as vibrotactile displays or novel visual (eg LED) displays. These prototypes will thus be used in the various experiments planned in the project.

8.2.4. *ANR ACOUSTIC*

Participant: Maud Marchal [contact].

ACOUSTIC is a 3-year ANR project (2011-2013). Partners of the project are : INSERM/University of Rennes 1, CRICM, University of Strasbourg, Inria (Hybrid and Shacra teams). The main objective of the project ACouStiC is to develop an innovative strategy based on models for helping decision-making process during surgical planning in Deep Brain Stimulation. Models rely on different levels involved in the decision-making process; namely multimodal images, information, and knowledge. The project aims at developing methods for 1) building generic and patient specific models and 2) automatically computing optimal electrodes trajectories from these models taking into account possible simulated deformations occurring during surgery. Hybrid is involved in the project with Inria team Shacra and aims at providing models of deformations of the cerebral structures and electrodes for the surgical planning. The objective is to propose a biomechanical approach to model the brain and electrode deformations and also their mutual interaction.

8.2.5. *ANR OpenViBE2*

Participants: Anatole Lécuyer [contact], Jozef Legény, Jonathan Mercier-Ganady.

OpenViBE2 is a 4-year ANR project (2009-2013) led by Anatole Lécuyer which ended in February 2013. Partners of the project were: Inria/Hybrid, INSERM, GIPSA-LAB, CEA, CHART, CLARTE, UBISOFT, BLACK SHEEP, and KYLOTONN GAMES. The objective of OpenViBE2 was to study the potential of Brain-Computer Interfaces (BCI) for videogames. OpenViBE2 has proposed a shift of perspective about the use of BCI. First, in OpenViBE2 we considered the possibility to merge a BCI with traditional peripherals such as joysticks, mice and other devices, all being possibly used simultaneously in a virtual environment. Therefore, BCI was not seen as a replacement but as a complement of classical HCI. Second, we aimed at monitoring brain cognitive functions and mental states of the user in order to adapt, in real-time and in an automated fashion, the interaction protocol as well as the content of the remote/virtual environment (VE).

8.2.6. *FUI SIFORAS*

Participants: Bruno Arnaldi [contact], Valérie Gouranton [contact], Thomas Lopez.

SIFORAS (Simulation for training and assistance) is a 3-year project (2011-2014) funded by the competitive cluster "Images et Réseaux". SIFORAS involves 4 academic partners (INSA Rennes, ENIB, CEA-List, ENISE) and 9 Industrial partners (Nexter Training, Delta CAD, Virtualys, DAF Conseils, Nexter Systems, DCNS, Renault, SNCF, Alstom). This project consists in developing a pedagogical system for technical training in industrial procedures. It aims at proposing Instructional Systems Design to answer the new objectives of training (Intelligent Tutorial System, mobility, augmented reality, high productivity). The Hybrid implication in the project shares some common means and goals with the Corvette project, in particular concerning its global architecture based on STORM and LORA models, and exploiting GVT software (section 5.2).

8.2.7. *FUI Previz*

Participants: Bruno Arnaldi [contact], Valérie Gouranton [contact].

Previz is a 3-year project (2013-2016) funded by the competitive cluster "Images et Réseaux". Previz involves 4 Academic partners (Hybrid/INSA Rennes, ENS Louis-Lumière, LIRIS, Gipsa-Lab) and 9 Industrial partners (Technicolor, Ubisoft, SolidAnim, loumasystem, Polymorph). Previz aims at proposing new previsualization tools for movie directors. The goal of Hybrid in Previz is to introduce new interactions between real and virtual actors so that the actor's actions, no matter his/her real or virtual nature, impact both the real and the virtual environment. The project will end up with a new production pipeline in order to automatically adapt and synchronize the visual effects (VFX), in space and time, to the real performance of an actor.

8.2.8. *ADT MAN-IP*

Participant: Valérie Gouranton [contact].

The ADT MAN-IP is a 2-year project (2013-2015) funded by Inria for software support and development. MAN-IP involves two Inria teams: Hybrid and MimeTIC. MAN-IP aims at proposing a common software pipeline for both teams to facilitate the production of populated virtual environments. The resulting software should include functionalities for motion capture, automatic aquisition and modification, and high-level authoring tools.

8.2.9. *ADT OpenViBE-NT*

Participants: Anatole Lécuyer [contact], Jussi Lindgren [contact], Jozef Legény.

The ADT OpenViBE-NT is a 2-year project (2012-2014) funded by Inria for support and development of the OpenViBE software (section 5.1). OpenViBE-NT involves four Inria teams: Hybrid, Potioc, Athena, Neurosys - all being extensive users of OpenViBE. OpenViBE-NT aims at improving the current functionalities of OpenViBE platform, and helping in supporting its active and ever growing community of users.

8.3. European Initiatives

8.3.1. *FP7 VISIONAIR*

Participants: Valérie Gouranton, Thierry Duval, Bruno Arnaldi.

- Program: FP7-INFRA
- Project acronym: VISIONAIR
- Project title: VISION Advanced Infrastructure for Research
- Duration: Feb 2011 - Feb 2015
- Coordinator: INPG
- Other partners: INPG France, University Patras Greece, Cranfield University United Kingdom, Universiteit Twente Netherlands, Universitaet Stuttgart Germany, ICBPP Poland, Univ. Méditerranée France, CNR Italy, Inria France, KTH Sweden, Technion Israel, RWTH Germany, PUT Poland, AMPT France, TUK Germany, University Salford United Kingdom, Fraunhofer Germany, I2CAT Spain, University Essex United Kingdom, MTASEAKI Hungary, ECN France, UCL United Kingdom, Polimi Italy, European Manufacturing and Innovation Research Association

- Abstract: Visionair calls for the creation of a European infrastructure for high level visualisation facilities that are open to research communities across Europe and around the world. By integrating existing facilities, Visionair aims to create a world-class research infrastructure for conducting state-of-the-art research in visualisation, thus significantly enhancing the attractiveness and visibility of the European Research Area. Hybrid team is mainly involved in Work Package 9 (Advanced methods for interaction and collaboration) led and supervised by Prof. Georges Dumont (MimeTIC Inria team).

8.4. International Initiatives

8.4.1. Associate Team SIMS

Participant: Maud Marchal [contact].

SIMS is an Inria Associate Team involving Mimetic and Hybrid Inria teams in Rennes and the GAMMA Research Group of the University of North Carolina in the United States. SIMS focuses on realistic and effective simulation of highly complex systems based on human movement and interaction. The Associate Team has three main axes of research: crowd simulation, movement planning for autonomous virtual humans and real-time physical simulation for interactive environments. The latter axis is supervised by Maud Marchal. In this context, one Master student spent 8 months in the GAMMA Research Group, starting in November 2013.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Dr. Francesco Grani, Postdoc at the Aalborg University, Denmark, spent a half month stay in our group in Rennes in June 2013 to work on auditory feedback in virtual environments, in the frame of EU FP7 "VISIONAIR" project.

8.5.2. Internships

- Mr. Takuya Sato, Master Student at the University of Tohoku in Sendai, Japan, spent a two-month internship in our group in Rennes in November and December 2013 to work on haptic feedback in collaborative virtual environments (Supervisors : Thierry Duval and Anatole Lécuyer).

8.5.3. Visits to International Teams

- Mr. Anthony Talvas, PhD student in the team, spent a three-month stay at University Rey Juan Carlos in Madrid, Spain, under the supervision of Pr. Miguel Otaduy. His stay was funded by Rennes Metropole.

Hycomes Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

- Ayman Aljarbooh's PhD is partially funded by a ARED grant of the Brittany Regional Council.
- Benoît Caillaud is participating to the S3PM project of the CominLabs excellence laboratory [10]. This project focuses on the computation of surgical procedural knowledge models from recordings of individual procedures, and their execution [7]. The objective is to develop an enabling technology for procedural knowledge based computer assistance of surgery. In this project, we demonstrate its potential added value in nurse and surgeon training.

6.2. National Initiatives

Program:« Briques génériques du logiciel embarqué » (Embedded Software Generic Building-Blocks)

Project acronym: Sys2soft

Project title: Physics Aware Software

Duration: June 2012 – April 2016

Coordinator: Dassault Systèmes (France)

Other partners: Thales TGS / TRT / TAS, Alstom Transport, Airbus, DPS, Obeo, Soyatec

Abstract: The Sys2soft project aims at developing methods and tools supporting the design of embedded software interacting with a complex physical environment. The project advocates a methodology where both physics and software are co-modeled and co-simulated early in the design process and embedded code is generated automatically from the joint physics and software models. Extensions of the Modelica language with synchronous programming features are being investigated, as a unified framework where interacting physical and software artifacts can be modeled.

6.3. European Initiatives

6.3.1. Collaborations in European Programs, except FP7

Program: ITEA2

Project acronym: Modrio

Project title: Model Driven Physical Systems Operation

Duration: September 2012 – November 2015

Coordinator: EDF (France)

Other partners: ABB (Sweden), Ampère Laboratory / CNRS (France), Bielefeld University (Germany), Dassault Systèmes (Sweden), Dassault Aviation (France), DLR (Germany), DPS (France), EADS (France), Equa Simulation (Sweden), IFP (France), ITI (Germany), Ilmenau University (Germany), Katholic University of Leuven (Belgium), Knorr-Bremse (Germany), LMS (France and Belgium), Linköping University (Sweden), MathCore (Sweden), Modelon (Sweden), Pöry (Finland), Qtronic (Germany), SICS (Sweden), Scania (Sweden), Semantum (Finland), Sherpa Engineering (France), Siemens (Germany and Sweden), Simpack (Germany), SKF (Sweden), Supmeca (France), Triphase (Belgium), University of Calabria (Italy), VTT (Finland), Vattenfall (Sweden), Wapice (Finland).

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[10]http://www.cominlabs.ueb.eu/projects/

Abstract: Modelling and simulation are efficient and widely used tools for system design. But they are seldom used for systems operation. However, most functionalities for system design are beneficial for system operation, provided that they are enhanced to deal with real operating situations. Through open standards the benefits of sharing compatible information and data become obvious: improved cooperation between the design and the operation communities, easier adaptation of operation procedures wrt. design evolutions. Open standards also foster general purpose technology. The objective of the ITEA 2 MODRIO project is to extend modelling and simulation tools based on open standards from system design to system operation.

6.4. International Initiatives

6.4.1. Informal International Partners

Beyond the Modrio and Sys2soft collaborative projects, we have an informal but sustained collaboration with the Dassault Systèmes team developping the Dymola tool, located in Lund, Sweden, and with the DLR in Munich, Germany, which are both prominent actors of the Modelica association. This collaboration has allowed us to have an impact on the recent evolution of the Modelica language: Version 3.3 of the language integrates several of our contributions related to the introduction of language constructs inherited from synchronous programming languages [11].

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[11] See acknowledgements in section E.1.3, page 261 of https://www.modelica.org/documents/ModelicaSpec33.pdf

<p style="text-align:center">**I4S Project-Team**</p>

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. Collaboration with ADVITAM
Participants: Laurent Mevel, Dominique Siegert, Ivan Gueguen.

contract 6841.

I4S is related to the project FUI SIPRIS (Systèmes d'Instrumentation pour la prévention des risques), lead by Advitam. Dominique Siegert and Ivan Gueguin handled instrumentation of a portique structure in Nantes for testing in scilab, matlab and lab view of modal analysis algorithms. Link with PEGASE platform have been done, testing and damage simulation have been performed. Internal report has been produced.

7.1.2. Collaboration with STX
Participants: Dominique Siegert, Ivan Gueguen.

Collaboration happened with STX during Fondeol project for the monitoring of foundation of wind turbine.

7.1.3. Collaboration with ISAE
Participants: Laurent Mevel, Ahmed Jhinaoui.

Ahmed Jhinaoui is finishing his thesis on helicopter instability. This thesis is codirected by professor Morlier from ISAE, France. This thesis is funded by FP7-NMP Large Scale Integrated Project IRIS.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. FP7 ISMS
Participants: Laurent Mevel, Michael Doehler.

Type: PEOPLE

Instrument: Industry-Academia Partnerships and Pathway (IAPP)

Duration: September 2010 - August 2014

Coordinator: SVS (Structural Vibrations Solutions) (Denmark)

Others partners: University of British Columbia, Canada

In 2009, a proposal has been submitted with SVS, University of British Columbia and I4S to develop a framework for handling structural health monitoring methods. This proposal implies some long stay of the concerned people, Laurent Mevel and Michael Doehler for I4S abroad. Palle Andersen and one of its engineer from SVS are assumed to stay 9 months at Inria, for tighten integration of COSMAD and ARTEMIS software. The proposal has been rated 88/100 and ranked A in the final selection procedure. The project has been signed on August 1st 2010 and has been running from September 1st. Michael Doehler has been spending 5 months in 2010-2011 in Denmark. Laurent Mevel spent 2 months in 2012 in Denmark. Palle Andersen was in Rennes in 2013 for 3 months. The mid term project has been well reviewed by the EC.

7.2.1.2. MODRIO Project
Participant: Qinghua Zhang.

MODRIO: Model Driven Physical Systems Operation. This ITEA 2 (Information Technology for European Advancement) project is joined by partners from Austria, Belgium, Finland, France, Germany, Italy and Sweden. See the complete of list of partners on the MODRIO page of the ITEA call website (https://itea3.org/all-projects/call-14.html).

To meet the evermore stringent safety and environmental regulations for power plants and transportation vehicles, system operators need new techniques to improve system diagnosis and operation. Open standards are necessary for different teams to cooperate by sharing compatible information and data. The objective of the MODRIO project is to extend modeling and simulation tools based on open standards from system design to system diagnosis and operation.

7.3. International Initiatives

7.3.1. Inria International Partners

7.3.1.1. SIMS, Canada
Participants: Michael Doehler, Laurent Mevel.

A new project called SIMS is currently ongoing on vibration analysis and monitoring in Canada. This project is funded by Ministry of Transport, British Columbia, Canada. It implies deep collaboration with University of British Columbia, Canada.

SVS and I4S are investigating how to link the modal analysis software ARTeMIS of SVS and COSMAD. Through an annual agreement, I4S gets a license of ARTeMIS in exchange to offer support for integrating our damage detection software into SVS software and offerings. I4S provides algorithms and expertise for integration within a damage detection structural health monitoring system and SVIBS does the implementation. This technology transfer has been funded by the ministry of transportation of British Columbia, Canada. The work is supervised by UBC, CA. The end product will be a web based structural health monitoring system for in operation bridges.

7.3.1.2. Collaboration on damage localization and monitoring with Boston University

This work is related to the thesis of Luciano Gallegos. The objective is the draft of an associated Inria team. Currently exchange of postdocs and joint PhD supervision have been done.

7.3.2. Participation In International Programs

7.3.2.1. Northeastern University
Participants: Laurent Mevel, Michael Doehler, Luciano Gallegos.

Program: International joint supervision of PhD agreement

Title: Design of fast statistical algorithms for monitoring of damage and uncertainties in civil and aeronautic structures

Inria principal investigator: Laurent MEVEL

Northeastern University (United States)

Duration: May 2011 - Apr 2014

This collaboration involves a PhD student, Luciano Gallegos, and is involving Professor Bernal from University of Boston, USA. The thesis has been defended in 2013.

7.4. International Research Visitors

7.4.1. Visits of International Scientists
Participants: Koen Tiels, Palle Andersen.

Palle Andersen was here for 3 months within ISMS project.

Koen Tiels from VUB in Bruxelles has visited us for 2 months in 2013.

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

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR Programme blanc GYPSI: 2010-2014

Participant: Nicolas Crouseilles.

Leader: Ph. Gendrih.

The full description is available at https://sites.google.com/site/anrgypsi/

6.1.2. ANR Programme blanc E2T2: 2010-2014

Participant: Nicolas Crouseilles.

Leader: P. Beyer

6.1.3. ANR Programme blanc STOSYMAP

Participant: Arnaud Debussche.

Leader: A. Shirikyan, The full description is available at http://shirikyan.u-cergy.fr/stosymap.html

6.2. European Initiatives

6.2.1. FP7 Projects

6.2.1.1. Geopardi

Title: Geometric Partial Differential Equations

Type: IDEAS ()

Instrument: ERC Starting Grant (Starting)

Duration: September 2011 - August 2016

Coordinator: Inria (France)

See also: http://www.irisa.fr/ipso/perso/faou/geopardi.html

Abstract: The goal is to develop new numerical methods for the approximation of evolution equations possessing strong geometric properties such as Hamiltonian systems or stochastic differential equations. Use intensive numerical simulations to discover and analyze new nonlinear phenomena.

6.2.2. Collaborations in European Programs, except FP7

ANR Programme blanc international (BLAN)

LODIQUAS 2012-2015

Low DImensional QUANtum Systems

Leaders: N. Mauser (Univ. Vienna) and F. Castella (IPSO).

Participants: François Castella, Philippe Chartier, Florian Me´hats, Mohammed Lemou.

Fundings for 4 postdocs (48 months) and one pre-doc (36 months).

The whole project involves the following researchers : Norbert Mauser (Vienna), Erich Gornik (Vienna), Mechthild Thalhammer (Innsbruck), Christoph Naegerl (Innsbruck), Jörg Schmiedmayer (Vienna), Hans-Peter Stimming (Vienna). François Castella (IPSO), Florian Méhats (IPSO), Francis Nier (Rennes), Raymond El Hajj (Rennes), Mohammed Lemou (IPSO), Claudia Negulsecu (Toulouse), Fanny Delebecque (Toulouse), Stéphane Descombes (Nice), Philippe Chartier (IPSO), Christophe Besse (Lille).

Abstract: Quantum technology as the application of quantum effects in macroscopic devices has an increasing importance, not only for far future goals like the quantum computer, but already now or in the near future. The present project is mainly concerned with the mathematical and numerical analysis of these objects, in conjunction with experimental physicists. On the side of fermions quantum electronic structures like resonant tunnelling diodes show well studied non classical effects like a negative differential resistance that are exploited for novel devices. On the side of bosons the creation and manipulation of Bose Einstein Condensates (the first creation of BECs by Ketterle et al merited a Nobel prize) has become a standard technique that allows to study fundamental quantum concepts like matter-wave duality with increasingly large objects and advanced quantum effects like decoherence, thermalization, quantum chaos. In state-of-the-art experiments e.g. with ultracold atoms in optical lattices the bosonic or fermionic nature of quantum objects can change and it makes a lot of sense to treat the models in parallel in the development of mathematical methods. The experimental progress in these fields is spectacular, but the mathematical modelling and analysis as well as the numerical simulation are lagging behind. Low dimensional models are mostly introduced in a heuristic way and there is also a need for systematic derivations and comparison with the 3-d models. To close the gap is a main goal of this project that aims to deliver reliable tools and programme packages for the numerical simulation of different classes of quantum systems modelled by partial differential equation of NLS type. Virtually all participants have a strong track record of international collaboration, they grew up with the concept of the European Research Area where science knows no boundaries and scientists used to work in different countries, as it was the case in a pronounced way in mathematics and in quantum physics in the thirties of the last century. The Pre- and Post-Docs to be funded by this project will be trained in this spirit of mobility between scientific fields and between places.

6.3. International Initiatives

6.3.1. Participation In other International Programs

- PTDC/EMS-ENE FCT (Fundação para a Ciência e a Tecnologia, Portugal): 2013-2014;
  Participant: N. Crouseilles;
  Leader: M. Roger
- IFCAM (Institute France-India for Applied Mathematics, India): 2013;
  Participant: N. Crouseilles and M. Lemou;
  Leaders: R. Raghurama, M. Lemou

6.4. International Research Visitors

6.4.1. Visits of International Scientists

- A. Debussche invited Y. Bakhtin (Georgia Tech., USA) and F. Baudoin (Purdue, USA) for a one month visit.
- L. Einkemmer, University of Innsbrück, one week, july 2013.
- A. Ruhi, Indian Institute of Sciences, 2 months, september-october 2013.
- R. Raghurama, Indian Institute of Sciences, two weeks, october 2013.
- Yong Zhang, under contract in Vienna, has been invited for several periods in Rennes (4 months altogether).

6.4.2. Visits to International Teams

- G. Vilmart: EPF Lausanne (Switzerland), invitation by Assyr Abdulle in the chair of numerical analysis and computational mathematics, several 1-2 weeks visits (totalizing 2 months).
- G. Vilmart: Invited research and teaching position at the University of Geneva, Section of Mathematics, for the period 09/2013-08/2014.

- N. Crouseilles visited the group of E. Sonnendrücker (IPP Garching, Germany), one week (december 2012).

- N. Crouseilles and E. Faou visited the group of A. Ostermann (University of Innsbrück, Austria), one week (march 2013).

- N. Crouseilles visited the group of P. Coelho (Universitad tecnico de Lisboa, Portugal), one week (july 2013).

- N. Crouseilles and M. Lemou visited the group of R. Raghurama (Indian Institute of Sciences, Bangalore (India)), 2 weeks (december 2013).

KERDATA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

MapReduce (2010–2014). An ANR project (ARPEGE 2010) with international partners, which focuses on optimized Map-Reduce data processing on cloud platforms. This project started in October 2010 in collaboration with Argonne National Lab, the University of Illinois at Urbana Champaign, the UIUC/Inria Joint Lab on Petascale Computing, IBM, IBCP, MEDIT and the GRAAL Inria Project-Team. URL: http://mapreduce.inria.fr/.

8.1.2. Other National projects

HEMERA (2010–2014). An Inria Large Wingspan Project, started in 2010. Within Hemera, G. Antoniu (KerData Inria Team) and Gilles Fedak (GRAAL Inria Project-Team) co-lead the Map-Reduce scientific challenge.

KerData also co-initiated a working group called *Efficient management of very large volumes of information for data-intensive applications*, co-led by G. Antoniu and Jean-Marc Pierson (IRIT, Toulouse).

Grid'5000. We are members of the Grid'5000 community: we make experiments on the Grid'5000 platform on a daily basis.

8.2. European Initiatives

8.2.1. FP7 Projects

The SCALUS FP7 Marie Curie Initial Training Network (2009–2013). Coordinator: André Brinkmann. Partners: Universidad Politécnica de Madrid (Spain), Barcelona Supercomputing Center (Spain), University of Paderborn (Germany), Ruprecht-Karls-Universität Heidelberg (Germany), Durham University (United Kingdom), FORTH (Greece), École des Mines de Nantes (France), XLAB (Slovenia), CERN (Switzerland), NEC (Germany), Microsoft Research (United Kingdom), Fujitsu (Germany), Sun Microsystems (Germany). Topic: scalable distributed storage. Abstract: The consortium of this Marie Curie Initial Training Network (MCITN) "SCALing by means of Ubiquitous Storage (SCALUS)" aims at elevating education, research, and development inside this exciting area with a focus on cluster, grid, and cloud storage. The vision of this MCITN is to deliver the foundation for ubiquitous storage systems, which can be scaled in arbitrary directions (capacity, performance, distance, security). We mainly collaborate with UPM (2 co-advised PhD theses).

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. DATA@EXASCALE

Title: Ulta-scalable I/O and storage for Exascale systems

Inria principal investigator: Gabriel Antoniu

International Partners (Institution - Laboratory - Researcher):

Argonne National Laboratory (United States) - Mathematics and Computer Science Division - Rob Ross

University of Illinois at Urbana Champaign (United States) - Marc Snir

Duration: 2013 - 2015

See also: http://www.irisa.fr/kerdata/data-at-exascale/

Description: as the computational power used by large-scale scientific applications increases, the amount of data manipulated for subsequent analysis increases as well. Rapidly storing this data, protecting it from loss and analyzing it to understand the results are significant challenges, made more difficult by decades of improvements in computation capabilities that have been unmatched in storage. For many applications, the overall performance and scalability becomes clearly driven by the performance of the I/O subsystem. As we anticipate Exascale systems in 2020, there is a growing consensus in the scientific community that revolutionary new approaches are needed in computational science storage. These challenges are at the center of the activities of the Joint Inria-UIUC Lab for Petascale Computing, recently extended to Argonne National Lab. This project gathers researchers from Inria, Argonne National Lab and the University of Illinois at Urbana Champaign to address 3 goals: 1) investigate new storage architectures for Exascale systems; 2) investigate new approaches to the design of I/O middleware for Exascale systems to optimize data processing and visualization, leveraging dedicated I/O cores and I/O forwarding techniques; 3) explore techniques enabling adaptive cloud data services for HPC.

8.3.2. Inria International Partners

8.3.2.1. Declared Inria International Partners

Politehnica University of Bucharest (since 1 January 2013, just after the end of our former Data-Cloud@work Associate Team).

8.3.3. Inria International Labs

Joint Inria-UIUC Lab for Petascale Computing (JLPC), since 2009. Collaboration on concurrency-optimized I/O for post-Petascale platforms (see details in Section 4.1). A joint project proposal with the team of Rob Ross (Argonne National Lab) has been completed in 2012. It served to prepare the creation of the Data@Exascale Associate Team with ANL and UIUC (2013-2015).

8.3.4. Participation In other International Programs

FP3C ANR-JST project (2010–2014). This project co-funded by ANR and by JST (Japan Science and Technology Agency) started in October 2010 for 42 months. It focuses on programming issues for Post-Petascale architectures. In this framework, KerData collaborates with the University of Tsukuba on data management issues.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Maria S. Perez (Universidad Politecnica de Madrid) and Toni Cortes (Universitat Politecnica de Catalunya) visited the KerData team for three days (December 2013) within the framework of the SCALUS project.

8.4.2. Internships

Participant: Mihaela Catalina Nita.

Subject: Smart Data Management for High-Performance Supercomputing

Date: from March 2013 until July 2013

Institution: Politehnica University of Bucharest (Romania)

Participant: Ana-Ruxandra Ion.

Subject: Enabling Map-Reduce-based Data-intensive Processing on Hybrid Cloud/Desktop Grid infrastructures

Date: from Mar 2013 until Jul 2013

Institution: Politehnica University of Bucharest (Romania)

Participant: Yue Li.

Subject: Energy Measurements for Cassandra Cloud Storage System: Exploring and improving Energy-Consistency Tradeoff

Date: from Feb 2013 until June 2013

Institution: Master student from Telecom Bretagne, Rennes (France)

Participant: Rui Wang.

Subject: Designing An Environment-Aware System for Geographically Distributed Data Transfers on Public Clouds

Date: from Feb 2013 until August 2013

Institution: Master student from Telecom Bretagne, Rennes (France)

8.4.3. Visits to International Teams

- Radu Tudoran visited ANL (Kate Keahey) for 3 months, funded by the Data@Exascale Associate Team.

- Matthieu Dorier visited ANL (Rob Ross, Tom Peterka, Phil Carns) for 2 months, funded by the Data@Exascale Associate Team.

- Radu Tudoran visited the ATL Lab at European Microsoft Innovation Center (Munich Germany) for 3 months, funded by Microsoft.

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. i-Lab ExtAR

Participants: Clément Samson, Eric Marchand.

duration: 24 months.

ExtAR is an Inria i-Lab with Artefacto that started in March 2011. Its goal was to develop an augmented reality library for smartphones.

8.1.2. Oseo Apash project

Participants: François Pasteau, Marie Babel.

no Insa Rennes 2012-230, duration: 24 months.

Started in September 2012, the Apash project is supported by the Images & Réseaux cluster. It involves three laboratories connected to INSA Rennes, namely Irisa/Inria, IETR and LGCGM. Two industrial partners take part into this project: AdvanSEE and Ergovie. It aims at designing a driving assistance for electrical wheelchair towards the autonomy and security of disabled people. The work realized within this project is described in Section 6.3.4 .

8.1.3. ARED NavRob

Participants: Suman Bista, Paolo Robuffo Giordano, François Chaumette.

no Inria Rennes 8033, duration: 36 months.

This project funded by the Brittany council started in October 2013. It supports in part Suman Bista's Ph.D. about visual navigation of a humanoid robot (see Section 8.2.4).

8.2. National Initiatives

8.2.1. ANR P2N Nanorobust

Participants: Le Cui, Eric Marchand.

no. UR1 11FA310-06D, duration: 48 months.

This project started in November 2011. It is composed of a consortium managed by Femto-ST in Besançon with LPN and Isir in Paris, Thalès and Lagadic group through the "Université de Rennes 1". Nanorobust deals with the development of micro- and nano-manipulation within SEM (Scanning Electron Microscope). Our goal is to provide visual servoing techniques for positioning and manipulation tasks with a nanometer precision.

8.2.2. ANR Contint Visioland

Participants: Patrick Rives, François Chaumette.

duration: 48 months.

This project started in November 2013. It is composed of a consortium managed by Onera in Toulouse with Airbus, Spikenet Technology, Irccyn, and Lagadic. It aims is to develop vision-based localization and navigation techniques for an autonomous landing on a runway.

8.2.3. PEA Decsa

Participants: Aurélien Yol, Eric Marchand.

no Inria Rennes 6630, duration: 36 months.

This project started in November 2011. It is composed of a consortium managed by Astrium with the Novadem, Sirehna, Spot Image and Magellium companies, and with the Inria Lagadic and Steep groups. It is devoted to the development of navigation and perception algorithms for small drones in urban environment.

8.2.4. Oseo Romeo 2

Participants: Nicolas Cazy, Suman Bista, Fabien Spindler, Paolo Robuffo Giordano, François Chaumette.

no Inria Rennes 7114, duration: 48 months.

This project started in November 2012. It is composed of a large consortium managed by Aldebaran Robotics. It aims to develop advanced control and perception functionalities to a humanoid robot. It supports in part Suman Bista's Ph.D. about visual navigation of a humanoid robot (see Section 8.2.4), as well as Nicolas Cazy's Ph.D. about model-based predictive control for visual servoing.

8.2.5. Equipex Robotex

Participants: Fabien Spindler, François Chaumette.

no Inria Rennes 6388, duration: 10 years.

Lagadic is one of the 15 French partners involved in the Equipex Robotex network. It is devoted to get significative equipments in the main robotics labs in France. In a near future, we plan to buy a humanoid robot, Romeo, by Aldebaran Robotics.

8.2.6. Inria large scale initiative action PAL

Participants: François Pasteau, Vishnu Narayanan, Cyril Joly, Marie Babel, Patrick Rives, François Chaumette.

Lagadic participates in the large-scale initiative action PAL (Personally Assisted Living) to develop technologies and services to improve the autonomy and quality of life for elderly and fragile persons. The purpose of PAL is to provide an experimental infrastructure, in order to facilitate the development of models, tools, technologies and concept demonstrations. Using the skills and objectives of the involved teams, four research themes have been defined: a) assessing the degree of frailty of the elderly, b) mobility of people, c) rehabilitation, transfer and assistance in walking, and d) social interaction. Lagadic is currently involved in the themes "mobility of people" and "assistance in walking" through collaborations with the EPI e-Motion (Grenoble), EPI Coprin (Sophia-Antipolis), and Handibio (Toulon). See Sections 6.2.3 , 6.3.4 , 6.3.5 and 6.4.4 .

Furthermore, the annual three-day PAL workshop has been organized in Rennes by François Pasteau, Marie Babel and Céline Gharsalli in July 2013.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. FP7 Space RemoveDEBRIS

Participants: Eric Marchand, Fabien Spindler, François Chaumette.

> Instrument: Specific Targeted Research Project
> Duration: from October 2013 till September 2016
> Coordinator: University of Surrey (United Kingdom)
> Partner: Surrey Satellite Technology (United Kingdom), Astrium (Toulouse, France and Bremen, Germany), Isis (Delft, The Netherlands), CSEM (Neuchâtel, Switzerland), Stellenbosch University (South Africa).
> Inria contact: François Chaumette
> Abstract: The goal of this project is to validate the model-based tracking algorithms developped during Antoine Petit's Ph.D. (see Section 6.1.1) on images acquired during an actual space debris removal mission.

8.3.1.2. FP7 Regpot Across
Participant: François Chaumette.

Program: Regpot

Project acronym: Across

Project title: Center of Research Excellence for Advanced Cooperative Systems

Duration: from September 2011 till March 2015

Coordinator: Prof. Ivan Petrovic from University of Zagreb (Croatia)

Other partners: KTH (Sweden), ETHZ (Switzerland), TUM (Germany), University of Manchester (UK), Vienna University of Technology (Austria), Politecnico di Milano (Italy), University of Sevilla (Spain), Eindhoven University of Technology (The Netherlands), University of Athens (Greece), etc.

Abstract: the goal of this project is to enhance collaborations with the University of Zagreb.

8.4. International Initiatives

8.4.1. Participation In other International Programs

- As a follow up to the long term collaboration with the "Centro de Tecnologia da Informação Renato Archer" (CTI) in Campinas (Brazil), a new Ph.D. student, Renato José Martins, joint the team in Sophia Antipolis thanks to a grant from the CNPq (2013-2017). He is co-directed by Patrick Rives and Samuel Siqueira Bueno from "Divisão de Robótica e Visão Computacional" at CTI. In the context of the project MuNave, funded by the Inria/CNPq Collaboration framework (2010-2012), Geraldo Silveira, researcher at CTI, has spent a one-week visit in Sophia Antipolis in May 2013.

- Alexandre Krupa started a collaboration with Nassir Navab from the Technische Universität München by beginning since September 2013 the joint supervision of Pierre Chatelain's Ph.D.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

- Raul Orlando Alvarado Lara and Francisco-Javier Rangel Butanda from the University of Guanajuato in Mexico did a 4-month master internship in Rennes. It was granted by Conacyt and their work was about visual servoing and 3D localization respectively.

- Ivan Markovic, Ph.D. student at the University of Zagreb, spent a three-month visit in Rennes in the scope of the FP7 Regpot Across project (see Section 8.3.1.2 and 6.3.6).

- Eduardo Moral-Fernandez, Ph.D. student at the Universidad de Malaga, Spain, visited our group in Sophia Antipolis from March to December 2013. He worked on dense SLAM using omnidirectional RGB-D sensors.

8.5.2. Visits to International Teams

- Manikandan Bakthavatchalam spent a three-month visit at ISR in Coimbra, Portugal, for collaborating with Omar Tahri about visual servoing based on photometric moments (see Section 6.2.1).

- Rafiq Sekkal spent a two-month visit at UPC in Barcelona, Spain, to collaborate with Ferran Marques on contour-based spatio-temporal segmentation (see Section 6.1.6).

- Pierre Chatelain spent a four-month visit in Nassir Navab'slab at TUM, Germany, in the scope of his Ph.D.

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

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR Contint: iSpace&Time

Participants: Fabrice Lamarche [contact], Julien Pettré, Marc Christie, Carl-Johan Jorgensen.

The iSpace&Time project is founded by the ANR and gathers six partners: IGN, Lamea, University of Rennes 1, LICIT (IFSTTAR), Telecom ParisTech and the SENSE laboratory (Orange). The goal of this project is the establishment of a demonstrator of a 4D Geographic Information System of the city on the web. This portal will integrate technologies such as web2.0, sensor networks, immersive visualization, animation and simulation. It will provide solutions ranging from simple 4D city visualization to tools for urban development. Main aspects of this project are:

- Creation of an immersive visualization based on panoramic acquired by a scanning vehicle using hybrid scanning (laser and image).
- Fusion of heterogeneous data issued by a network of sensor enabling to measure flows of pedestrians, vehicles and other mobile objects.
- Use of video cameras to measure, in real time, flows of pedestrians and vehicles.
- Study of the impact of a urban development on mobility by simulating vehicles and pedestrians.
- Integration of temporal information into the information system for visualization, data mining and simulation purpose.
- The mimetic team is involved in the pedestrian simulation part of this project. This project started in 2011 and will end in 2014.

8.1.2. ANR Contint: Chrome

Participants: Julien Pettré [contact], Kevin Jordao, Orianne Siret.

The Chrome project is leaded by Julien Pettré, member of MimeTIC. Partners are: Inria-Grenoble IMAGINE team (Remi Ronfard), Golaem SAS (Stephane Donikian), and Archivideo (Francois Gruson). The project has been launched in september 2012.

The Chrome project develops new and original techniques to massively populate huge environments. The key idea is to base our approach on the crowd patch paradigm that enables populating environments from sets of pre-computed portions of crowd animation. These portions undergo specific conditions to be assembled into large scenes. The question of visual exploration of these complex scenes is also raised in the project. We develop original camera control techniques to explore the most relevant part of the animations without suffering occlusions due to the constantly moving content. A far term goal of the project is to enable populating a large digital mockup of the whole France (Territoire 3D, provided by Archivideo). Dedicated efficient Human animation techniques are required (Golaem). A strong originality of the project is to address the problem a crowded scene visualisation thorugh the scope of virtual camera control (Inria Rennes and Grenoble)

8.1.3. ANR TecSan: RePLiCA

Participant: Armel Crétual [contact].

The goal of RePLiCA project is to build and test a new rehabilitation program for facial praxia in children with cerebral palsy using an interactive device. RePLiCA started in january 2012 and will end in July 2015.

In a classical rehabilitation program, the child tries to reproduce the motion of his/her therapist. The feedback he/she has lays on the comparison of different modalities: the gesture of the therapist he/she has seen few seconds ago (visual space) and his/her own motion (proprioceptive space). Unfortunately, besides motor troubles these children often have some cognitive troubles and among them a difficulty to convert the information from a mental space to another one.

The principle of our tool is that during a rehabilitation session the child will observe simultaneously on the same screen an avatar, the virtual therapist's one, performing the gesture to be done, and a second avatar animated from the motion he actually performs. To avoid the use of a too complex motion capture system, the child will be filmed by a simple video camera. One first challenge is thus to be able to capture the child's facial motion with enough accuracy. A second one is to be able to provide him/her an additional feedback upon the gesture quality comparing it to a database of healthy children of the same age.

8.1.4. ANR JCJC: Cinecitta

Participants: Marc Christie [contact], Cunka Sanokho.

Cinecitta is a 3-year young researcher project funded by the French Research Agency (ANR) lead by Marc Christie. The project started in October 2012 and will end in October 2015.

The main objective of Cinecitta is to propose and evaluate a novel workflow which mixes user interaction using motion-tracked cameras and automated computation aspects for interactive virtual cinematography that will better support user creativity. We propose a novel cinematographic workflow that features a dynamic collaboration of a creative human filmmaker with an automated virtual camera planner. We expect the process to enhance the filmmaker's creative potential by enabling very rapid exploration of a wide range of viewpoint suggestions. The process has the potential to enhance the quality and utility of the automated planner's suggestions by adapting and reacting to the creative choices made by the filmmaker. This requires three advances in the field. First, the ability to generate relevant viewpoint suggestions following classical cinematic conventions. The formalization of these conventions in a computationally efficient and expressive model is a challenging task in order to select and propose the user with a relevant subset of viewpoints among millions of possibilities. Second, the ability to analyze data from real movies in order to formalize some elements of cinematographic style and genre. Third, the integration of motion-tracked cameras in the workflow. Motion-tracked cameras represent a great potential for cinematographic content creation. However given that tracking spaces are of limited size, there is a need to provide novel interaction metaphors to ease the process of content creation with tracked cameras. Finally we will gather feedback on our prototype by involving professionals (during dedicated workshops) and will perform user evaluations with students from cinema schools.

8.1.5. ANR Contint: ENTRACTE

Participants: Charles Pontonnier [contact], Georges Dumont, Nicolas Bideau, Franck Multon, Julien Pettré, Richard Kulpa, Ana Lucia Cruz Ruiz, Steve Tonneau.

The ANR project ENTRACTE is a collaboration between the Gepetto team in LAAS, Toulouse (head of the project) and the Inria/MimeTIC team. The project started in November 2013 and will end in August 2017. The purpose of the ENTRACTE project is to address the action planning problem, crucial for robots as well as for virtual human avatars, in analyzing human motion at a biomechanical level and in defining from this analysis bio-inspired motor control laws and bio-inspired paradigms for action planning. The project is launched since november 2013 and Ana-Lucia Cruz-Ruiz has been recruited as a PhD student since this date to begin to work on musculoskeletal-based methods for avatar animation. Moreover, Steve Tonneau, a PhD student currently entering in its third year is also developing bio-inspired posture generators for avatar navigation in encumbered environments.

8.1.6. ADT: Man-IP

Participant: Franck Multon [contact].

The ADT-MAN-IP aims at proposing a common production pipeline for both MimeTIC and Hybrid teams. This pipeline intends to facilitate the production of populated virtual reality environments.

The pipeline starts with the motion capture of an actor, using motion capture devices such as a Vicon (product of Oxford Metrics) system. To do so, we need to design new methods to automatically adapt all motion captures data to an internal skeleton that can be reused to retarget the motion to various types of skeletons and characters. The purpose is then to play this motion capture data on any type of virtual characters used in the demos, regardless their individual skeletons and morphology. The key point here is to make this process be as automatic as possible.

The second step in the pipeline is to design a high level scenario framework to describe a virtual scene and the possible user's interactions with this scene so that he/she can interact with the story directly.

In this ADT we also will have to connect these two opposite parts into a unique framework that can be used by non-experts in computer animation to design new immersive experiments involving autonomous virtual humans. The resulting framework could consequently be used in the Immersia immersive room for various types of application.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. INFRA-FP7: VISIONAIR
Participants: Georges Dumont [contact], Charles Pontonnier.

Acronysm: VISIONAIR

Title: VISION Advanced Infrastructure for Research

Duration: 2011-2015

See also:http://www.infra-visionair.eu/

The european project VISIONAIR began in February 2011 in the infrastructure call of FP7. The project's goal is to create a European infrastructure that should be a unique, visible and attractive entry towards high level visualization facilities. These facilities will be open to the access of a wide set of research communities. By integrating our existing facilities, we will create a world-class research infrastructure enabling to conduct frontier research. This integration will provide a significant attractiveness and visibility of the European Research Area. The partners of this project have proposed to build a common infrastructure that would grant access to high level visualization and interaction facilities and resources to researchers. Indeed, researchers from Europe and from around the world will be welcome to carry out research projects using the visualization facilities provided by the infrastructure. Visibility and attractiveness will be increased by the invitation of external projects.

This project is built with the participation of 26 European partners.

Our actual Virtual Reality systems allowed us to be a key partner within this European project. Our Immersia (http://www.irisa.fr/immersia) Virtual Reality room is, in Europe, a key place for virtual reality. We are leading the Work Package 9 on Advanced methods for interaction and collaboration of this project and are deeply involved in the directory board and in the scientific piloting committee.

Within the frame of this project, studies on VR and sports about basketball throwing (see 6.4) and VR and ergonomics about fidelity of virtual environments for ergonomic applications (see 6.2) have been leaded.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. FORMOSA
Title: Fostering Research on Models for Storytelling Applications

Inria principal investigator: Marc Christie

Partner contact: Pr. Tsai Yen li

International Partner (Institution - Laboratory - Researcher):

National Cheng Chi University (Taiwan) - Intelligent Media Lab - Marc Christie

Duration: 2013 - 2015

See also: http://www.irisa.fr/mimetic/GENS/mchristi/EA-FORMOSA/

The application context targeted by this proposal is Interactive Virtual Storytelling. The growing importance of this form of media reveals the necessity to re-think and re-assess the way narratives are traditionally structured and authored. In turn, this requires from the research community to address complex scientific and technical challenges at the intersection of literature, robotics, artificial intelligence, and computer graphics. This joint collaboration addresses three key issues in virtual storytelling: (i) delivering better authoring tools for designing interactive narratives based on literary-founded narrative structures, (ii) establishing a bridge between the semantic level of the narrative and the geometric level of the final environment to enable the simulation of complex and realistic interactive scenarios in 3D, and (iii) providing a full integration of the cinematographic dimension through the control of high-level elements of filmic style (pacing, preferred viewpoints, camera motion). The project is founded on a past solid collaboration and will rely on the team's complementarity to achieve the tasks through the development of a joint research prototype.

8.3.1.2. SIMS

Title: Toward realistic and efficient simulation of highly complex systems

Inria principal investigator: Julien Pettré

Partner contact: Pr. Ming Lin

International Partner (Institution - Laboratory - Researcher):

University of North Carolina at Chapel Hill (United States) - GAMMA Research Group - Julien Pettré

Duration: 2012 - 2014

See also: http://www.irisa.fr/mimetic/GENS/jpettre/

The general goal of SIMS is to make significant progress toward realistic and efficient simulation of highly complex systems which raise combinatory explosive problems. This proposal is focused on human motion and interaction, and covers 3 active topics with wide application range: 1. Crowd simulation: virtual human interacting with other virtual humans, 2. Autonomous virtual humans: who interact with their environment, 3. Physical Simulation: real humans interacting with virtual environments. SIMS is orthogonally structured by transversal questions: the evaluation of the level of realism reached by a simulation (which is a problem by itself in the considered topics), considering complex systems at various scales (micro, meso and macroscopic ones), and facing combinatory explosion of simulation algorithms.

8.4. International Research Visitors

8.4.1. Internships

- Alexandra Covaci, PhD student from University Brassov (Romania) partially funded by the VISION-AIR project and Brassov University, from March to April 2013. Joint works about virtual training in sports applied to basketball free throw.

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. ASYST (2010-2013)

Participants: Djawida Dib, Christine Morin, Nikos Parlavantzas.

The objective of the ASYST project (*Adaptation dynamique des fonctionnalités d'un SYSTème d'exploitation large échelle*) funded by the Brittany council is to propose building distributed operating systems as sets of adaptable services. This project funds 50% of a PhD grant (Djawida Dib). In 2013, we have worked on the design and implementation of Meryn [24], a flexible PaaS system that supports dynamically resizing virtual clusters to satisfy SLAs involving completion time and prices.

8.2. National Initiatives

8.2.1. COOP ANR COSINUS Project (2009-2013)

Participants: Yvon Jégou, Christine Morin, Yann Radenac.

The COOP project (http://coop.gforge.inria.fr/) funded under the ANR COSINUS program relates to multi level cooperative resource management. The two main goals of this project are to set up a cooperation as general as possible with respect to programming models and resource management systems (RMS) and to develop algorithms for efficient resource selection. Experimentations were conducted in particular with the SALOME platform and TLSE as examples of programming environments and Marcel, DIET and XtreemOS as examples of RMS. Partners involved in the COOP project are the AVALON and RUNTIME INRIA EPI, IRIT and EDF R&D. This project funds a research engineer (Yann Radenac). In 2013, we completed the design and implementation of the modifications needed in XtreemOS Grid distributed operating system in order to integrate the CooRM architecture defined by the Avalon Inria team to support dynamic applications.

8.2.2. MIHMES ANR Investissements d'Avenir (2012 - 2018)

Participants: Yvon Jégou, Christine Morin.

The MIMHES project (http://www.inra.fr/mihmes) led by INRA/BioEpAR aims at producing scientific knowledge and methods for the management of endemic infectious animal diseases and veterinary public health risks. Myriads team will provide software tools to efficiently manage and ease the use of a distributed computing infrastructure for the execution of different simulation applications.

In 2013, we interacted with the INRA/BioEpAR research team in order to improve the initial software prototype and to make it ready for parallelisation. The code has been re-written in C++. In 2014, Inria is in charge of developing a parallel version of the code.

8.2.3. HEMERA Inria AEN (2010-2013)

Participants: Bogdan Florin Cornea, Yvon Jégou, Christine Morin, Anne-Cécile Orgerie.

The Myriads team is involved in the HEMERA large wingspan project funded by INRIA (http://www.grid5000.fr/mediawiki/index.php/Hemera). This project aims at demonstrating ambitious up-scaling techniques for large scale distributed computing by carrying out several dimensioning experiments on the Grid'5000 infrastructure, at animating the scientific community around Grid'5000 and at enlarging the Grid'5000 community by helping newcomers to make use of Grid'5000. Yvon Jégou is co-chair of the "Bring Grids Power to Internet-Users thanks to Virtualization Technologies" working group. Anne-Cécile Orgerie is involved in the "Energy" working group which is currently looking at making energy-aware experiments on Grid'5000 easier for the users. This project funds Bodgan Florin Cornea's postdoc.

8.2.4. Inria ADT Aladdin (2008-2013)

Participants: Yvon Jégou, David Margery, Pascal Morillon.

The Aladdin technological development action funded by INRIA aims at the construction of a scientific instrument for experiments on large-scale parallel and distributed systems, building on the Grid'5000 platform (http://www.grid5000.fr).

As governing body of Grid'5000, it was superseded by a national GIS (Scientific interest group) that was signed in 2012.

As the host of engineers contributed to Grid'5000's technical team by INRIA, it finished operating in 2013. Two engineers of this technical team who are SED [7] members are still hosted in the Myriads team: David Margery, technical director and Pascal Morillon. Pascal Morillon is the chief engineer for all tasks automating Grid'5000 administration.

8.2.5. Inria ADT Snooze (2012-2014)

Participants: Eugen Feller, Yvon Jégou, David Margery, Christine Morin, Anne-Cécile Orgerie, Matthieu Simonin.

The Snooze technological development action funded by INRIA aims at developing an IaaS cloud environment based on the Snooze virtual machine framework developed by the team (http://snooze.inria.fr) and to make this new environment available to a wide community.

In 2013, we validated Snooze at large scale on the Grid'5000 testbed. A poster was presented at CCGRID 2013 [35] and the results of the study were awarded the second prize at CCGRID2013 scale challenge [26]. We introduced the Apache Casssandra system as database backend in Snooze. We have also started to refactor some parts of the code to enable the use of plugins. We implemented an EC2 interface and a web GUI. Puppet recipes were also released as well as a capistrano based deployment script for Grid'5000.

8.2.6. CNRS GDS EcoInfo

Participant: Anne-Cécile Orgerie.

The EcoInfo group deals with reducing environmental and societal impacts of Information and Communications Technologies from hardware to software aspects. This group aims at providing critical studies, lifecycle analyses and best practicies in order to improve the energy efficiency of printers, servers, data centers, and any ICT equipment in use in public research organizations.

8.2.7. CominLabs EPOC project (2013-2016)

Participants: Sabbir Hasan, Yunbo Li, Anne-Cécile Orgerie, Jean-Louis Pazat.

In this project, partners aim at focusing on energy-aware task execution from the hardware to application's components in the context of a mono-site data center (all resources are in the same physical location) which is connected to the regular electric Grid and to renewable energy sources (such as windmills or solar cells). In this context, we tackle three major challenges:

- Optimizing the energy consumption of distributed infrastructures and service compositions in the presence of ever more dynamic service applications and ever more stringent availability requirements for services.

- Designing a clever cloud's resource management which takes advantage of renewable energy availability to perform opportunistic tasks, then exploring the trade-off between energy saving and performance aspects in large-scale distributed systems.

- Investigating energy-aware optical ultra high-speed interconnection networks to exchange large volumes of data (VM memory and storage) over very short periods of time.

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[7]The SED is the INRIA Experimentation and Development Service.

8.2.8. IRT B-Com

Participants: Yvon Jégou, Jean-Louis Pazat, Édouard Outin.

Yvon Jégou and Jean-Louis Pazat are at IRT B-Com [8] one day per week, Yvon Jégou since October 1st and Jean-Louis Pazat since September 1st. With Édouard Outin, B-com phd student, they contribute to the B-Com Indeed project which aims at developing a distributed cloud software stack with a high degree of adaptability.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. CONTRAIL

> Type: COOPERATION
>
> Defi: Internet of Services, Software & Virtualisation
>
> Instrument: Integrated Project
>
> Objectif: Internet of Services, Software and Virtualisation
>
> Duration: October 2010 - September 2013
>
> Coordinator: Inria
>
> Partner: XLAB Razvoj Programske Opreme In Svetovanje d.o.o., Slovenia; Italian National Research Council, ISTI-CNR & IIT-CNR, Italy; Vrije Universiteit Amsterdam, The Netherlands; Science and Technology Facilities Council, STFC, UK; Genias Benelux bv, The Netherlands; Tiscali Italia SpA, Italy; Konrad-Zuse-Zentrum für Informationstechnik Berlin, ZIB, Germany; Hewlett Packard Italiana S.r.l - Italy Innovation Center, Italy; Country Constellation Technologies Ltd, UK; Linagora, France.
>
> Inria contact: Christine Morin
>
> Abstract: The goal of the Contrail project is to design, implement, evaluate and promote an open source system for Cloud Federations. Resources that belong to different operators will be integrated into a single homogeneous federated Cloud that users can access seamlessly. The Contrail project will provide a complete Cloud platform which integrates Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS) offerings [39].

In 2013, we led the evaluation of Contrail software stack [57]. We also completed the design and implementation of VEP [56], [51] advanced features such as the reservation manager and scheduler. We defined a revised version of the API and implemented the CIMI interface. We ported VEP on top of the OpenStack IaaS management system. We worked on the integration of VEP with the other Contrail components. We set up an open permanent testbed for VEP and a testbed running Contrail software stack for internal use by consortium members to allow extensive tests with applications. Christine Morin is the coordinator of Contrail project and Roberto Cascella is the technical manager. Christine Morin leads WP 10 on Contrail global architecture. Yvon Jégou leads WP 5 on VEP and WP 13 on testbeds.

8.3.1.2. BonFIRE

> Type: COOPERATION
>
> Defi: Future internet experimental facility and experimentally-driven research
>
> Instrument: Integrated Project
>
> Objectif: ICT-2009.1.6
>
> Duration: June 2010 - December 2013
>
> Coordinator: Atos Spain SA (Spain)

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[8] http://b-com.org/wp/

Partner: The university of Edinburgh (U.K.); SAP AG (Germany); Universitaet Stuttgart (Germany); Fraunhofer-Gesellschaft zur Foaerung der Angewandten Forshung E.V (Germany); Interdisciplinary Institute for Broadband Technology (Belgium); Universidad Complutense De Madrid (Spain) ; Fundacio Privada I2CAT, Internet I Innovacio Digital A Catalunya (Spain); Hewlett-Packard Limited (U.K.); The 451 Group Limited (U.K.) Techniche Universitat Berlin (Germany); University of Southampton (U.K.); Inria (France); Instytut Chemii Bioorganicznej Pan (Poland); Nextworks (Italy); Redzinc Services Limited (Ireland); Cloudium systems Limited (Ireland); Fundacio Centro Technologico De Supercomputacion De Galicia (Spain); Centre d'Excellence en technologies de l'Information et de la communication (Belgium); University of Manchester (U.K.);

Inria contact: David Margery

Abstract: The BonFIRE (Building service testbeds for Future Internet Research and Experimentation) project has designed, built and operated a multi-site cloud facility to support applications, services and systems research targeting the Internet of Services community within the Future Internet (http://www.bonfire-project.eu). The Myriads team is involved in this project as it hosts the Aladdin ADT.

In the context of BonFIRE, we operate one of the five cloud sites integrated into the BonFIRE cloud federation. This cloud site is based on OpenNebula and can be extended on-request to all the machines of the local Grid'5000 site. We have also contributed to the cloud federation layer and host the integration infrastructure for the project, generated from configuration management tools using puppet.

8.3.1.3. PaaSage

Type: COOPERATION

Objectif: ICT-2011.1.2 Cloud Computing, Internet of Services and Advanced Software Engineering

Instrument: Collaborative Project

Duration: October 2012 - September 2016

Coordinator: GEIE ERCIM (France)

Partner: SINTEF (Norway), Science and Technology Facilities Council (UK), University of Stuttgart (Germany), Inria (France), Centre d'Excellence en Technologies de l'Information et de la Communication (Belgium), Foundation for Research and Technology Hellas (Greece), BE.Wan SPRL (Belgium), EVRY AS (Norway), SysFera SAS (France), Flexiant Limited (UK), Lufthansa Systems AG (Germany), Gesellschaft fur Wissenschaftliche Datenverarbeitung MBH Gottingen (Germany), Automotive Simulation Center Stuttgart (Germany), University of Ulm (Germany), Akademia Górniczo-Hutnicza im. Stanisława Staszica (Poland), University of Cyprus (Cyprus), IBSAC-Intelligent Business Solutions ltd (Cyprus), University of Oslo (Norway)

Inria contact: Nikos Parlavantzas

See also: http://www.paasage.eu/

Abstract: PaaSage aims to deliver an open and integrated platform to support both deployment and design of Cloud applications, together with an accompanying methodology that allows model-based application development, configuration, optimisation, and deployment on multiple Cloud infrastructures.

8.3.1.4. Fed4FIRE

Type: COOPERATION

Defi: Future internet experimental facility and experimentally-driven research

Instrument: Integrated Project

Objectif: ICT-2011.1.6 Future Internet Research and Experimentation (FIRE) with a specific focus on b) FIRE Federation

Duration: June 2010 - December 2013

Coordinator: ATOS SPAIN SA (Spain)

Partner: Interdisciplinary institute for broadband technology (iMinds, Belgium), University of Southampton (It Innovation, United Kingdom) Universite Pierre et Marie Curie - paris 6 (UPMC, France) Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.v (Fraunhofer, Germany) Technische Universitat Berlin (TUB, Germany) The University of Edinburgh (UEDIN, United Kingdom) National Ict Australia Limited (NICTA, Australia) Atos Spain SA (Atos, Spain) Panepistimio Thessalias (University of Thessaly) (UTH, Greece) National Technical University of Athens (NTUA, Greece) University of Bristol (UNIVBRIS, United Kingdom) Fundacio Privada i2cat, Internet I Innovacio Digital a Catalunya (i2cat, Spain) Eurescom-European Institute for Research and Strategic Studies in Telecommunications (EUR, Gmbh Germany) Delivery of Advanced Network Technology to Europe limited (DANTE limited, United Kingdom) Universidad de Cantabria (UC, Spain) National Information Society agency (NIA, Korea (republic of))

Inria contact: David Margery

Abstract: In Fed4FIRE, we investigate the means by which our experimental platforms (BonFIRE, and in a secondary way Grid'5000) could be made interoperable with a wider eco-system of experimental plateforms in Europe and beyond. The baseline architectural choice for this project is to use the key concepts of the Slice Federation Architecture (SFA) to provision resources on experimental platforms, a Control and Management Framework for Networking Testbeds named OMF for experiment control and OML, the OMF Measurment library for data collection. We investigate whether these can be used to run experiments on BonFIRE and how they need to be extended to support to operating model of BonFIRE.

8.3.1.5. ECO2Clouds

Type: COOPERATION

Defi: Future internet experimental facility and experimentally-driven research

Instrument: Specific Targeted Research Project

Objectif: ICT-2011.1.6 – Target outcome c) FIRE Experimentation

Duration: October 2012 - September 2014

Coordinator: Atos Spain SA (Spain)

Partner: Atos Spain SA (ATOS, Spain) The University of Manchester (UNIMAN, United Kingdom) The University of Edinburgh (UEDIN, United Kingdom) Universitaet Stuttgart (USTUTT, Germany) Politecnico di Milano (POLIMI, Italy)

Inria contact: David Margery

Abstract: In ECO_2Clouds, we add to BonFIRE energy probes to be able to measure power consumption of the infrastructure, combine it with information about energy sources used to produce the power so as to be able to bill Co_2 usage to experimenters running VMs. To allow for scheduling and adaptation of running applications, CO_2 usage is not only billed after the fact but also quoted in advance for a given period for according to resource usage units.

8.3.1.6. HARNESS

Type: COOPERATION

Defi: Pervasive and Trusted Network and Service Infrastructures

Instrument: Small or medium-scale focused research project

Objectif: ICT-2011.1.2 Cloud Computing, Internet of Services and Advanced Software Engineering

Duration: October 2012 - September 2015

Coordinator: Imperial College London (IMP, United Kingdom)

Partner: Ecole polytechnique fédérale de Lausanne (EPFL, Switzerland), Université de Rennes 1 (UR1, France), Konrad-Zuse-Zentrum für Informationtechniek Berlin (ZIB, Germany), Maxeler Technologies (MAX, United Kingdom), SAP AG (SAP, Germany)

UR1 contact: Guillaume Pierre

Abstract: The HARNESS FP7 project aims to incorporate innovative hardware and network technologies seamlessly into data centres that provide platform-as-a-service cloud infrastructures.

The dominant approach in offering cloud services today is based on homogeneous commodity resources: large numbers of inexpensive machines, interconnected by off-the-shelf networking equipment, supported by stock disk drives. However, cloud service providers are unable to use this platform to satisfy the requirements of many important and high-value classes of applications.

Today's cloud platforms are missing out on the revolution in new hardware and network technologies for realising vastly richer computational, communication, and storage resources. Technologies such as Field Programmable Gate Arrays (FPGA), General-Purpose Graphics Processing Units (GPGPU), programmable network routers, and solid-state disks promise increased performance, reduced energy consumption, and lower cost profiles. However, their heterogeneity and complexity makes integrating them into the standard Platform as a Service (PaaS) framework a fundamental challenge.

The HARNESS project brings innovative and heterogeneous resources into cloud platforms through a rich programme of research, validated by commercial and open source case studies.

8.3.2. Collaborations in European Programs, except FP7

8.3.2.1. ICT COST
Participants: Eugen Feller, Christine Morin, Anne-Cécile Orgerie.

Program: ICT COST

Project acronym: IC0804

Project title: Energy efficiency in large scale distributed systems

Duration: 23/01/2009 - 04/05/2013

Coordinator: Professor Jean-Marc PIERSON, IRIT, France, http://www.irit.fr/cost804/

Other partners: 22 COST countries and 7 non-COST institutions

Abstract: The COST Action IC0804 proposes realistic energy-efficient alternate solutions to share IT distributed resources. As large scale distributed systems gather and share more and more computing nodes and storage resources, their energy consumption is exponentially increasing. While much effort is nowadays put into hardware specific solutions to lower energy consumptions, the need for a complementary approach is necessary at the distributed system level, i.e. middleware, network and applications. The Action characterizes the energy consumption and energy efficiencies of distributed applications. Then based on the current hardware adaptation possibilities and innovative algorithms it proposes adaptive and alternative approaches taking into account the energy saving dimension of the problem. The Action characterizes the trade-off between energy savings and functional and non-functional parameters, including the economic dimension.

In April 2013, Anne-Cécile Orgerie presented a demonstration of Snooze system at the final COST workshop [36].

8.3.2.2. MC-DATA

Program: EIT ICT Labs

Project acronym: MC-DATA

Project title: Multi-Cloud Data Management

Duration: Jan 2013 - Dec 2014

Coordinator: Imperial College London (IMP, United Kingdom)

Other partners: Université de Rennes 1 (UR1, France), Konrad-Zuse-Zentrum für Informationtechniek Berlin (ZIB, Germany), Swedish Institute of Computer Science (SICS, Sweden), Vodafone (Germany)

Abstract: the MC-DATA project has two main innovation objectives: (a) to provide and release a novel open-source Platform-as-a-Service (PaaS) cloud computing software stack (MC-ConPaaS) that explicitly targets cloud application deployments across multiple data centers; (b) to demonstrate the business value of the MC-ConPaaS platform through a use case of cloud-assisted real-time smartphone applications, thus affecting the future business models of mobile operators.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. DALHIS

Title: Data Analysis on Large Heterogeneous Infrastructures for Science

Inria principal investigator: Christine Morin

International Partner:

Lawrence Berkeley National Laboratory (United States) - Advanced Computing for Science department led by Deb Agarwal

Duration: 2013 - 2015

See also: http://project.inria.fr/dalhis

The worldwide scientific community is generating large datasets at increasing rates causing data analysis to emerge as one of the primary modes of science. Existing data analysis methods, tools and infrastructure are often difficult to use and unable to handle the "data deluge". A scientific data analysis environment needs to address three key challenges: a) programmability: easily user composable and reusable programming environments for analysis algorithms and pipeline execution, b) agility: software that can adapt quickly to changing demands and resources, and, c) scalability: take advantage of all available resource environments including desktops, clusters, grids, clouds and HPC environments. The goal of the DALHIS associated team is to coordinate research and create together a software ecosystem to facilitate data analysis seamlessly across desktops, HPC and cloud environments. Specifically, our end goal is to build a dynamic environment that is user-friendly, scalable, energy-efficient and fault tolerant through coordination of existing projects. We plan to design a programming environment for scientific data analysis workflows that will allow users to easily compose their workflows in a programming environment such as Python and execute them on diverse high-performance computing (HPC) and cloud resources. We will develop an orchestration layer for coordinating resource and application characteristics. The adaptation model will use real-time data mining to support elasticity, fault-tolerance, energy efficiency and provenance. We will investigate how to provide execution environments that allow users to seamlessly execute their dynamic data analysis workflows in various research environments.

8.4.2. Inria International Partners

8.4.2.1. Informal International Partners

We collaborate on cloud computing with Stephen Scott, Professor at Tennessee Tech University (TTU) and researcher at Oak Ridge National Laboratory (ORNL). He visited Myriads team in September 2013 to investigate research directions for future joint work on cloud computing for scientific applications. We also collaborate on cloud computing with Kate Keahey from Argonne National Laboratory. She chairs the Contrail European project scientific advisory board. Nikos Parlavantzas is involved in an informal collaboration with Héctor Duran Limon, Professor at the University of Guadalajara, Mexico, who came for a 1 week visit in February 2013.

8.4.3. Inria International Labs

Christine Morin was the Inria@Silicon Valley scientific manager until August 2013. She co-organized with Eric Darve, professor at Stanford University and the Inria international relations department the Berkeley-Inria-Stanford workshop (BIS 2013) held at Stanford University in May 2013. Several Myriads team members (Eugen Feller, Christine Morin, Anne-Cécile Orgerie, Cédric Tedeschi) are involved in the DALHIS associate team on data analysis on large-scale heterogeneous infrastructures for science, which is part of the Inria@SiliconValley program. She was also involved in an informal collaboration with the CITRIS Social Apps Lab, led by James Holston and Greg Niemeyer from UC Berkeley. Collaboration opportunities between Inria and the Social Apps Lab on smart cities and social sustainability were investigated.

8.5. International Research Visitors

8.5.1. Visits to International Teams

Christine Morin was on sabbatical until August 2013 in the Advanced Computing for Science department at the Lawrence Berkeley National Laboratory (USA). Eugen Feller has been a post-doc in the Advanced Computing for Science department at the Lawrence Berkeley National Laboratory (USA) as part of the Inria@Silicon Valley program since February 2013. He is involved in the DALHIS associate team.

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

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. OSEO: QUAERO CTC and Corpus Projects
Participants: Frédéric Bimbot, Laurence Catanese, Gabriel Sargent.

Main academic partners : IRCAM, IRIT, LIMSI, Telecom ParisTech

Duration: 2008 -december 2013

Research axis: 3.3

Description: Quaero is a European research and development program with the goal of developing multimedia and multilingual indexing and management tools for professional and general public applications (such as search engines).

Partners: Other companies involved in the consortium are: France Télécom, Exalead, Bertin Technologies, Jouve, Grass Valley GmbH, Vecsys, LTU Technologies, Siemens A.G. and Synapse Développement. Many public research institutes are also involved, including LIMSI-CNRS, Inria, IRCAM, RWTH Aachen, University of Karlsruhe, IRIT, Clips/Imag, Telecom ParisTech, INRA, as well as other public organisations such as INA, BNF, LIPN and DGA.

Funding: This program is supported by OSEO.

Coordinator: The consortium is led by Technicolor.

Contribution of PANAMA:

PANAMA is involved in two technological domains : audio processing and music information retrieval (WP6). The research activities (CTC project) are focused on improving audio and music analysis, segmentation and description algorithms in terms of efficiency, robustness and scalability. Some effort is also dedicated on corpus design, collection and annotation (Corpus Project).

PANAMA also takes part to research and corpus activities in multimodal processing (WP10), in close collaboration with the TEXMEX project-team.

8.1.2. OSEO-FUI: S-POD: "Assistance à personnes en danger potentiel"
Participants: Frédéric Bimbot, Romain Lebarbenchon.

Duration: August 2012-November 2016

Research axis: 3.2

Partners: ERYMA, CAPT/FOTON, CASSIDIAN, KAPTALIA, KERLINK, le LOUSTIC and Telecom Bretagne

Coordinator: ERYMA

Description: S-POD gathers research teams and industrial partners to that aim at setting up a framework to process and fuse audio, physiological and contextual data. The goal is to design an embedded autonomous system able to detect situations of potential danger arising in the immediate environment of a person (military, police, CIT, fire, etc.)

Contribution of PANAMA: PANAMA is in charge of R&I activities related to the qualitative and quantitative analysis of information from the acoustic environment (intensity, direction of arrival, nature of noise sounds, properties of voices, etc.) as well as to the exploitation of these analyses. The need for real-time embedded processing induces specific constraints.

8.1.3. Action de Développement Technologique: FASST

Participants: Nancy Bertin, Frédéric Bimbot, Jules Espiau de Lamaestre, Nathan Souviraà-Labastie.

Duration: 2 years (2012–2014).

Research axis: 3.2.2

Partners: Inria Teams Parole (Nancy) and Texmex (Rennes)

Description: This Inria ADT aims to develop a new version of our FASST audio source separation toolbox in order to facilitate its large-scale dissemination in the source separation community and in the various application communities. A specific effort will be made towards the speech processing community by developing an interface with existing speech recognition software. A beta version was internally released and tested from July 2013. The first public release is planned for January 2014.

8.2. European Initiatives

8.2.1. ERC-StG: PLEASE (Projections, Learning, and Sparsity for Efficient Data Processing)

Participants: Rémi Gribonval, Srdan Kitic, Pierre Machart, Cagdas Bilen, Luc Le Magoarou, Nancy Bertin.

Duration: January 2012 - December 2016

Research axis: 3.1

Principal investigator: Rémi Gribonval

Program: ERC Starting Grant

Project acronym: PLEASE

Project title: Projections, Learning and Sparsity for Efficient data processing

Abstract: The Please ERC is focused on the extension of the sparse representation paradigm towards that of *sparse modeling*, with the challenge of establishing, strengthening and clarifying connections between sparse representations and machine learning

Web site: https://team.inria.fr/panama/projects/please/

8.2.2. Eureka-Eurostars: i3DMusic

Participant: Laurent Simon.

Duration: October 2010 - September 2013

Research axis: 3.2.2

Partners: Audionamix (FR), Sonic Emotion (CH), École Polytechnique Fédérale de Lausanne (CH), PANAMA (FR)

Program: Eureka - Eurostars

Project acronym: i3DMusic

Project title: Real-time Interative 3D Rendering of Musical Recordings

Abstract:The i3DMusic project (Real-time Interative 3D Rendering of Musical Recordings) has been setup with the SMEs Audionamix and Sonic Emotion and the academic partner EPFL to provide a system enabling real-time interactive respatialization of mono or stereo music content. This will be achieved through the combination of source separation and 3D audio rendering techniques. Metiss is responsible for the source separation work package, more precisely for designing scalable online source separation algorithms and estimating advanced spatial parameters from the available mixture.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- Mike Davies, from May until July, Professor of Signal and Image Processing, University of Edinburgh
- Anders Hansen, from April until April, Research Fellow Royal Society, Center for Mathematical Sciences, University of Cambridge
- Dan Stowell, from March until March, Postdoctoral research assistant, Center for Digital Music, Queen Mary University of London
- Bob Sturm, from March until March, Assistant Professor, Aalborg University Copenhagen
- Boris Mailhé, from March until March, Postdoctoral research assistant, Center for Digital Music, Queen Mary University of London
- Simon Foucart, from March until March, Assistant Professor, Drexel University

8.3.2. Internships

- Anwaya Aras, from July until December, Third year undergraduate, Department of Computer Science BITS-Pilani, India.
- Emmanuel Deruty, from April to September, PhD Preparatory year, Musicology Department, Catholic University Louvain, Belgium

S4 Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

...

8.2. National Initiatives

8.2.1. *Synchronics: Language Platform for Embedded System Design*
Participants: Albert Benveniste, Benoît Caillaud.

Large scale initiative funded by INRIA. *http://synchronics.inria.fr/*

This project, started Jan 1st 2008, is supported by INRIA. It capitalizes on recent extensions of data-flow synchronous languages (mode automata, Lucid Synchrone, Signal, Lustre, ReactiveML, relaxed forms of synchronous composition or compilation techniques for various platforms). We aim to address the main challenges of embedded system design, starting from a single, semantically well founded programming language.

Our contributions to Synchronics in 2012 are:

- A journal paper [] presenting the non-standard semantics for hybrid systems and its applications to the semantics and compilation of hybrid modeling languages. Details can be found in Section .

- Inputs to the latest evolution of the Modelica language, related to state machines and a clock calculus.

- A study of modular code generation techniques for reactive synchronous programming languages, based on an interface theoretic approach [], []. See for further details.

8.3. European Initiatives

8.3.1. *FP7 Projects*

8.3.1.1. DALI

Type: COOPERATION

Defi: ICT for Health, Ageing Well, Inclusion and Governance

Instrument: Specific Targeted Research Project

Objectif: ICT for Ageing and Wellbeing

Duration: November 2011 - October 2014

Coordinator: ___COORDINATOR___???

Partner: ___DEPARTEMENT???___, ___INSTITUTION???___ (Italy)

Inria contact: Axel Legay

Abstract: ___RESUME???___

8.3.2. Collaborations in European Programs, except FP7

8.3.3. Collaborations with Major European Organizations

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.2. Inria International Partners

8.4.2.1. Declared Inria International Partners

8.4.2.2. Informal International Partners

8.4.3. Inria International Labs

8.4.4. Participation In other International Programs

8.4.4.1. ___SIGLE???___

> Program: International joint supervision of PhD agreement
>
> Title: Contrôle de l'opacité dans les systèmes distribués à flots de tâches basés sur le partage de documents structurés
>
> Inria principal investigator: Eric BADOUEL
>
> International Partner (Institution - Laboratory - Researcher):
> > University Cheikh Anta Diop of Dakar (Senegal) - Eric BADOUEL
>
> Duration: Dec 2010 - Dec 2013
>
> See also: ___URL???___
> ___ABSTRACT???___

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

8.5.2. Visits to International Teams

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Brittany council: FRACINI project

Participants: Jean-Raynald de Dreuzy, Jocelyne Erhel, Géraldine Pichot.

Contract with Brittany council
Duration: one year from December 2013.
Title: European initiative towards models and numerical methods for simulations in fractured-porous geological media.
Coordination: Géraldine Pichot.
Partners: Geosciences Rennes.
Web page: http://www.irisa.fr/sage/
Abstract: FRACINI is an initiative funded by the Région Bretagne. It aims at gathering researchers from the European community working on models and numerical methods for simulations in fractured-porous media. Two international workshops will be organized in 2014. The overall objective of these workshops is to end up with a submission of a proposal in response to the Future and Emerging Technology (FET) call of H2020 Funding.

8.2. National Initiatives

8.2.1. ANR-MN: H2MNO4 project

Participants: Édouard Canot, Jocelyne Erhel, Grégoire Lecourt, Aurélien Le Gentil, Lionel Lenôtre, Géraldine Pichot, Souhila Sabit.

Contract with ANR, program Modèles Numériques
Duration: four years from November 2012.
Title: Original Optimized Object Oriented Numerical Model for Heterogeneous Hydrogeology.
Coordination: Jocelyne Erhel and Géraldine Pichot, with Fabienne Cuyollaa.
Partners: Geosciences Rennes, University of Poitiers, University of Lyon 1, Andra, Itasca.
International collaborations: University of San Diego (USA), UPC, Barcelona (Spain)
Web page: http://h2mno4.inria.fr/
Abstract: The project H2MNO4 develops numerical models for reactive transport in heterogeneous media. It defines six mathematical and computational challenges and three applications for environmental problems with societal impact (see 6.3 , 5.1.1).

8.2.2. Inria Project Lab: HEMERA project

Participants: Jocelyne Erhel, Géraldine Pichot.

Title: Hemera - developing large scale parallel and distributed experiments
Duration: September 2010 - July 2014
Coordination: C. Perez, Avalon team.
Partners: 22 Inria teams.
Webpage: http://www.grid5000.fr/mediawiki/index.php/Hemera
Abstract: Hemera is an Inria Project Lab, started in 2010, that aims at demonstrating ambitious up-scaling techniques for large scale distributed computing by carrying out several dimensioning experiments on the Grid'5000 infrastructure, at animating the scientific community around Grid'5000 and at enlarging the Grid'5000 community by helping newcomers to make use of Grid'5000.

The team Sage is the leader of the Scientific Challenge Hydro: Multi-parametric intensive stochastic simulations for hydrogeology. The objective is to run multiparametric large scale simulations (see 6.3).

8.2.3. *Inria Project Lab: C2S@EXA project*

Participants: Édouard Canot, Thomas Dufaud, Jocelyne Erhel, Géraldine Pichot, Souhila Sabit.

Title: C2S@EXA - Computer and Computational Scienecs at Exascale
Duration: from January 2012.
Coordination: S. Lanteri, Nachos team.
Partners: Inria teams working on HPC; external partners: ANDRA and CEA.
Webpage: http://www-sop.inria.fr/c2s_at_exa/
Abstract: The C2S@Exa Inria Project Lab is concerned with the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society (see 6.1 , 6.3 , 6.4). The team participated in several workshops.

8.2.4. *Inria Technological development actions: H2OGuilde project*

Participants: Jocelyne Erhel, Aurélien Le Gentil, Grégoire Lecourt, Géraldine Pichot.

Title: H2OGuilde - Graphical User Interface and Library Development for H2OLab platform
Duration: October 2011 - October 2013.
Coordination: J. Erhel and G. Pichot.
Partner: Charles Deltel, SED Inria Rennes
Webpage: http://www.irisa.fr/sage/
Abstract: The project H2OGuilde aims at developing an interface for the platform H2OLab and at designing software libraries with a large academic diffusion (see 5.1.1 ,5.1.5 , 5.1.4).

8.2.5. *Inria Collaborative Research Action: GEOFRAC project*

Participants: Thomas Dufaud, Jocelyne Erhel, Géraldine Pichot.

Title: GEOFRAC
Duration: June 2011-June 2013.
Coordinator: J. Erhel and G. Pichot.
Partners: Pomdapi and Gamma3 Inria teams, Géosciences Rennes.
Webpage: http://www.irisa.fr/sage/geofrac/
Abstract: In the last twenty years, the interest of geological fractured rocks has been renewed by a variety of energy-related applications, such as carbonate oil reservoirs, geothermic energy production, geological storage of high level nuclear waste, geological sequestration of CO_2. Fractures are highly permeable pathways within a less pervious but more porous medium generally called matrix. The discrete modeling of fractures faces at least two challenging numerical issues. First, the fracture and matrix phases have very different hydraulic properties. Permeability is at least two orders of magnitude larger in the fractures than in the matrix. Second, the fracture structure complexity yield intricate geometrical configurations difficult to mesh. We propose to address these limitations by developing new numerical methods (see 6.4 , 5.1.1).

8.2.6. *GENCI: project on advanced linear solvers*

Participants: Édouard Canot, Jocelyne Erhel, Grégoire Lecourt, Lionel Lenôtre, Géraldine Pichot.

Title: Scalabilité de méthodes numériques pour l'hydrogéologie
Duration: 2012
Coordination: J. Erhel and G. Pichot.
Webpage: http://www.genci.fr/
Abstract: To run large scale simulations, we defined a project, based on the software H2OLab, SBM, PALMTREE and GRT3D. We obtained and used computing time on machines located at GENCI supercomputing centers. (see 6.1 , 6.3).

8.2.7. GNR MOMAS: project on reactive transport

Participants: Jocelyne Erhel, Souhila Sabit.

Webpage: https://www.ljll.math.upmc.fr/cances/gdrmomas/

The working group MOMAS includes many partners from CNRS, Inria, universities, CEA, ANDRA, EDF and BRGM. It covers many subjects related to mathematical modeling and numerical simulations for nuclear waste disposal problems (see 6.3 , 6.4). The team participated in workshops.

8.3. European Initiatives

8.3.1. FP7: EXA2CT project

Title: EXascale Algorithms and Advanced Computational Techniques

Instrument: Specific Targeted Research Project

Duration: September 2013 - August 2016

Coordinator: S. Ashby, IMEC, Belgium

Partners: 10 partners

Inria contact: Luc Giraud

Web page: https://projects.imec.be/exa2ct/

Abstract: The goal of this project is to develop novel algorithms and programming models to tackle what will otherwise be a series of major obstacles to using a crucial component of many scientific codes at exascale, namely solvers and their constituents. The results of this work will be combined in running programs that demonstrate the application-targeted use of these algorithms and programming models in the form of proto-applications.

8.3.2. Collaborations with Major European Organizations

UPC: Universitat Politècnica de Catalunya-UPC, Institute of Environmental Assessment and Water Research (Spain)

numerical simulations in hydrogeology, reactive transport in heterogeneous media, upscaling, scientific software platform (see 5.1.1 , 6.3.1 , 6.4).

UFZ: Helmholtz Centre for Environmental Research-UFZ, Hydrogeology group (Germany)

numerical simulations in hydrogeology, flow in porous fractured media, scientific software platform

HPCLab: University of Patras, High Performance Information Systems Laboratory (Greece)

cooperation with B. Philippe in writing a book, and in common research on low rank approximations of matrix functions.

ERCIM: working group on numerical algorithms, high performance computing.

8.4. International Initiatives

8.4.1. Informal International Partners

University of Kent (USA)

Krylov methods

University of Purdue (USA)

High Performance Scientific Computing

University of San Diego (USA)

Hydrogeology

8.4.2. LIRIMA laboratory: momappli team (Cameroon)

Participant: Bernard Philippe.

Program: Laboratoire International de Recherche en Informatique et Mathématiques Appliquées

Title: Modélisation Mathématique et Applications

Inria principal investigator: Bernard Philippe

International Partner (Institution - Laboratory - Researcher): University of Yaounde, Cameroon - Norbert Noutchegueme

Duration: 2010-2013

See also: http://www.lirima.uninet.cm/index.php/recherche/equipes-de-recherche/momappli

Abstract: The team deals with high performance scientific computing, with a focus on reliable tools for localizing eigenvalues of large sparse matrices (see 6.1.4).

8.4.3. LIRIMA laboratory: EPIC team (Tunisia)

Participants: Amine Abdelmoula, Jocelyne Erhel, Sinda Khalfallah, Bernard Philippe.

Program: Laboratoire International de Recherche en Informatique et Mathématiques Appliquées

Title: Problèmes Inverses et Contrôle

Inria principal investigator: Houssem Haddar, Defi team

International Partner (Institution - Laboratory - Researcher): ENIT, University of Tunis, Tunisia - LAMSIN - Amel ben Abda

Duration: 2011-2013

See also: http://www.lirima.uninet.cm/index.php/recherche/equipes-de-recherche/epic

Abstract: The team deals with nonlinear and inverse problems.

8.4.4. Joint Laboratory for Petascale Computing (USA)

Participant: Jocelyne Erhel.

Program: Joint Laboratory for Petascale Computing

Inria principal investigator: Franck Cappello and Laura Grigori, Grand Large team

International Partner (Institution - Laboratory - Researcher): University of Illinois at Urbana-Champaign, USA - Marc Snir and Bill Gropp

Duration: 2011-2013

See also: http://jointlab.ncsa.illinois.edu/

Abstract: The team works on deflation methods and their integration into the software PETSc (see 6.1.1); the team works also on domain decomposition methods (see 6.4.2).

8.4.5. CEDRE program: MODNUM project (Lebanon)

Participants: Édouard Canot, Jocelyne Erhel, Bernard Philippe.

Program: CEDRE Lebanon

Title: Modélisation numérique pour des applications libanaises

Inria principal investigator: Jocelyne Erhel and Bernard Philippe

International Partner (Institution - Laboratory - Researcher): American University of Beirut (Lebanon)

Duration: Jan 2012 - Dec 2013

Abstract: the project deals with numerical parallel algorithms and with applications to archaeology.

8.4.6. ECOS Sud (Argentina): ARPHYMAT project
Participant: Édouard Canot.

Program: COFECUB

Title: Processus de formation et transformation de structures de combustion archéologique

Inria principal investigator: Édouard CANOT

International Partner (Institution - Laboratory - Researcher): University of Buenos Aires (Argentina)

Duration: Jan 2012 - Dec 2014

Abstract: the project concerns numerical simulations of prehistoric fires and comparison with archaeological data in South America.

8.4.7. Inria Euromediterranean: HYDRINV project
Participants: Édouard Canot, Jocelyne Erhel, Sinda Khalfallah, Bernard Philippe.

Program: Euromediterranean 3+3

Title: Direct and inverse problems in subsurface flow and transport

Coordination: H. ben Ameur, ENIT, Tunisia and J. Jaffré, Inria, Paris

Inria-Rennes principal investigator: Jocelyne Erhel

International Partners (Institution - Laboratory - Researcher):

Université Ibn Tofail - Faculté des Sciences de Kénitra (Morocco) - Laboratoire Interdisciplinaire en Ressources Naturelles et en Environnement - Zoubida Mghazli

Ecole Nationale d'Ingénieurs de Tunis (Tunisia) - Laboratoire de Modélisation en Hydraulique et Environnement - Rachida Bouhlila

Universidad de Sevilla (Spain) - Department Ecuaciones Diferenciales y Análisis Numérico - Tomas Chacon Rebollo

Universitat Politècnica de Catalunya (Spain) - Department of Geotechnical Engineering and Geo-Sciences - Xavier Sànchez Vila

University Centre of KHEMIS MILIANA (Algeria) - Laboratoire de l'Energie et des Systèmes Intelligents - Mohammed Hachama

Ecole Mohammadia d'Ingénieurs (Morocco) - LERMA - Rajae Aboulaich

Ecole Nationale d'Ingénieurs de Tunis (Tunisia) - Laboratoire de Modélisation Mathématique et Numérique dans les Sciences de l'Ingénieur - Hend Ben Ameur

Duration: Jan 2012 - Dec 2015

The management of water resources is a problem of great importance in all countries, and is particularly acute around the Mediterranean sea. The goal is to find a reasonable balance between these resources and demand while preserving the quality of water. Towards this goal it is essential to understand and simulate flow and transport in the subsurface. The science corresponding to this topic is hydrogeology. Since models become more and more complicated and quantitative answers must be given, numerical modeling become more and more sophisticated and mathematicians must also be involved. This project brings together hydrogeologists and mathematicians from France, Spain, Algeria, Morocco and Tunisia in order to develop, analyze, and validate numerical methods for several problems arising from modeling flow and transport in the subsurface. The emphasis is put on direct nonlinear problems (air-water flow, density driven flow related to salinization, transport with chemistry) and on inverse problems.

8.4.8. *Joint supervision of M. Oumouni's PhD (Morroco)*

Participants: Jocelyne Erhel, Mestapha Oumouni.

Program: International joint supervision of PhD agreement

Title: Méthodes numériques et leur analyse pour la résolution des équations de l'écoulement et de transport en milieux poreux hétérogènes et aléatoires

Inria principal investigator: Jocelyne Erhel

International Partner (Institution - Laboratory - Researcher): University Ibn Tofail - Faculté des Sciences de Kénitra (Morocco) - Zoubida Mghazli

Duration: Jan 2009 - June 2013

Abstract: see 6.3.3 .

8.4.9. *Joint supervision of A. Abdelmoula's PhD (Tunisia)*

Participants: Amine Abdelmoula, Bernard Philippe.

Program: International joint supervision of PhD agreement

Title: Résolution de problèmes inverses en géodésie physique

Inria principal investigator: Bernard Philippe

International Partner (Institution - Laboratory - Researcher): Ecole Nationale d'Ingénieurs de Tunis - LAMSIN (Tunisia) - Maher Moakher

Duration: 2005 - 2013

Abstract: The objective is to compute a set of point-mass which generate an a priori given gravitational field (see 8.4.7 , 8.4.3).

8.4.10. *Joint supervision of S. Khalfallah's PhD (Tunisia)*

Participants: Jocelyne Erhel, Sinda Khalfallah.

Program: International joint supervision of PhD agreement

Title: Contribution à l'analyse mathématique et numérique de quelques problèmes issus de l'hydrogéologie

Inria principal investigator: Jocelyne Erhel

International Partner (Institution - Laboratory - Researcher): Ecole Nationale d'Ingénieurs de Tunis - LAMSIN (Tunisia) - Amel ben Abda

Duration: 2010 - 2014

Abstract: The objective is to solve data completion problems applied to hydrogeology (see 8.4.7 , 8.4.3).

8.5. International Research Visitors

8.5.1. *Visits of International Scientists*

- Emmanuel Kamgnia, University of Yaoundé, 2 months, March-April 2013
- Nabil Nassif, American University of Beirut, 3 weeks, July 2013, November 2013, December 2013
- Stratis Gallopoulos, Uiversity of Patras, 1 week, August 2013
- Ahmed Sameh, University of Purdue, 1 week, August 2013
- Mohamad Muhieddine, Libanese University, 2 weeks, June 2013
- Lamia Guellouz, University of Tunis, 1 week, December 2013

8.5.2. *Internships (Joint supervision of Ph-D students*

- Louis-Bernard Nguenang, University of Yaoundé, 4.5 months, March-July 2013

- Mestapha Oumouni, University of Kenitra, 3 months, March-June 2013
- Marwen ben Refifa, University of Tunis, 3 months, April-July 2013
- Salwa Mansour, Lebanese University, 7 months, Feb-Aug 2013

8.5.3. Visits to International Teams

- Édouard Canot, ENIT Tunis, Tunisia, 1 week, February 2013 (project HYDRINV)
- Jocelyne Erhel and Géraldine Pichot, UPC Barcelona, Spain, 1 week, April 2013 (project H2MNO4)
- Édouard Canot and Salwa Mansour and Bernard Philippe, Beirut, Lebanon, 1 week, May 2013 (project MODNUM)
- Édouard Canot, ANCBA Buenos Aires, Argentina, 2 weeks, November 2013 (project ARPHY-MAT)
- Bernard Philippe, Yaoundé, Cameroon, 1 week, December 2013 (project MOMAPPLI)

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SERPICO Project-Team

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8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. RTR SISCom project

Participant: Charles Kervrann.

In this project, we developed new statistical restoration algorithms for fluorescence and electron imaging and PSF (point-spread function) and CTF (contrast transfer function) correction, respectively. An integrated highly focused approach combing the efforts of three teams in image processing (Serpico), in-vivo light microscopy (IGDR-CeDRE) and cryo-electron tomography (IGDR-TIPs) has been studied to produce novel computational strategies for biological imaging.

 Funding: RTR Syscom, European University of Brittany (UEB): 12 months
 Partners: UMR 6290 – IGDR (Institut de Génétique et Développement de Rennes)

8.2. National Initiatives

8.2.1. Quaero project

Participants: Charles Kervrann, Patrick Bouthemy, Denis Fortun, Pierre Allain, Thibault Geffroy.

Quaero is a European collaborative research and development program with the goal of developing multimedia and multi-lingual indexing and management tools for professional and public applications. SERPICO team participates in the Work Package 9 on Video Processing (WP9) of QUAERO Core Technology Cluster Project (CTC). Within WP9, former Vista project-team leaded three tasks: "Motion Recognition", "Object Tracking" and "Event Recognition". Since October 2010, SERPICO has conducted activities in object tracking and indexing for video-microscopy analysis (Denis Fortun PhD grant) and Thibault Geffroy (Master 1 INSA Rouen).

 Funding: Quaero (no. Inria Alloc 3184), duration: 60 months
 Partners: 24 academic and industrial partners leaded by Technicolor

8.2.2. ANR GreenSwimmers project

Participant: Charles Kervrann.

Biofilms are composed of spatially organized microorganisms (possibly including pathogens) embedded in an extracellular polymeric matrix. A direct time-lapse confocal microscopic technique was recently developed to enable the real-time visualization of biocide activity within the biofilm. It can provide information on the dynamics of biocide action in the biofilm and the spatial heterogeneity of bacteria-related susceptibilities that are crucial for a better understanding of biofilm resistance mechanisms. The approach is here to characterize the spatial and temporal exploration of the biofilm by microorganisms.

In this project, SERPICO develop methods and software for the computation of mean velocity as well as other descriptors of swimmers bacteria dynamics inside biofilm image sequences. We investigate spatio-temporal features and descriptors for comparison, classification, indexing and retrieval.

 Funding: ANR, duration: 24 months
 Partners: INRA, AgroParisTech, Naturatech company

8.2.3. France-BioImaging project

Participants: Charles Kervrann, Patrick Bouthemy, Tristan Lecorgne, Tinaherinantenaina Rakotoarivelo, Thierry Pécot.

The goal of the project is to build a distributed coordinated French infrastructure for photonic and electronic cellular bioimaging dedicated to innovation, training and technology transfer. High computing capacities are needed to exhaustively analyse image flows. We address the following problems: i/ exhaustive analysis of bioimaging data sets; ii/ deciphering of key steps of biological mechanisms at organ, tissular, cellular and molecular levels through the systematic use of time-lapse 3D microscopy and image processing methods; iii/ storage and indexing of extracted and associated data and metadata through an intelligent data management system. SERPICO is co-head of the IPDM (Image Processing and Data Management) node of the FBI network composed of 6 nodes.

Funding: Investissement d'Avenir - Infrastructures Nationales en Biologie et Santé (2011-2016)
Partners: CNRS, Institut Jacques Monod, Institut Pasteur, Institut Curie, ENS Ulm, Ecole Polytechnique, INRA, INSERM

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations

ESFRI Euro-BioImaging initiative: SERPICO participates in the ESFRI Euro-BioImaging project, one of the four new biomedical science projects in the roadmap of the European Strategic Forum on Research Infrastructures (ESFRI). The mission of Euro-BioImaging is to provide access, service and training to state-of-the-art imaging technologies and foster the cooperation and networking at the national and European level including multidisciplinary scientists, industry regional, national and European authorities. (3-year Preparatory Phase / start: December 2010). SERPICO also participates in the French counterpart, the so-called "France-BioImaging" (FBI) network which gathers several outstanding cellular imaging centers (microscopy, spectroscopy, probe engineering and signal processing) as described in Section 8.2.3 .

8.4. International Research Visitors

8.4.1. Visits to International Teams

- Collaboration with Harvard Medical School (Boston, MA), Prof. G. Danuser, on object tracking in video-microscopy (P. Roudot's visit in 2012-2013, 3 months, Inria & CNRS grant).

- Collaboration with University of California - San Francisco (USA), J. Sedat and D. Agard, on image denoising in cryo-electron microscopy.

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

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR-PERSEE

Participants: Christine Guillemot, Laurent Guillo, Olivier Le Meur.

- Title : Perceptual coding for 2D and 3D images.
- Research axis : § 6.2.1 , 6.1.1 .
- Partners : IRCCYN-Polytech Nantes, INSA-Rennes, Telecom Paris Tech.
- Funding : ANR.
- Period : Oct.2009-Aug.2013

The objective of the project is to develop perceptually driven coding solutions for mono-view and multi-view video. The SIROCCO project-team contributes on different problems for mono-view and multi-view video coding: visual attention modeling (see Section 6.1.1), texture synthesis and inpainting for both 2D and 3D content. Several methods for 2D image inpainting and 2D/3D inpainting to handle disocclusions in virtual view synthesis have been developed (see Sections 6.2.1 . A computational model for 3D content has also been studied (see Section 6.1.1).

8.1.2. ANR-ARSSO

Participants: Mounira Ebdelli, Christine Guillemot, Ronan Le Boulch, Olivier Le Meur, Aline Roumy.

- Title : Adaptable, Robust, Streaming SOlutions.
- Research axis: 6.2.1 , 6.4.1
- Partners : Inria/Planète, TESA-ISAE, CEA-LETI/LNCA, ALCATEL LUCENT BELL LABS, THALES Communications, EUTELSAT SA.
- Funding : ANR.
- Period : 06/2010-11/2013

The ARSSO project focuses on multimedia content communication systems, characterized by more or less strict real-time communication constraints, within highly heterogeneous networks, and toward terminals potentially heterogeneous too. It follows that the transmission quality can largely differ in time and space. The solutions considered by the ARSSO project must therefore integrate robustness and dynamic adaptation mechanisms to cope with these features. The overall goal is to provide new algorithms, develop new streaming solutions and study their performances. The SIROCCO project-team contributes on the development of loss concealment methods based on video inpainting. The solutions developed in 2012 have been studied in the context of a video compression and transmission chain using the emerging HEVC coding standard and have been integrated in the project demonstrator.

8.2. European Initiatives

8.2.1. FP7-PEOPLE-SHIVPRO

Participants: Olivier Le Meur, Zhi Liu.

- Title : Saliency-aware High-resolution Video Processing.
- Research axis : 6.1.1 .
- Partners : Visting professor from Shanghai University.
- Funding : EC-FP7 MC-IIF International Incoming Fellowships (IIF).
- Period : 08/2012-07/2014

The proposal SHIVPRO (Saliency-aware High-resolution Video Processing) submitted to the call FP7-PEOPLE-2011-IIF (funding scheme: MC-IIF International Incoming Fellowships (IIF)) has been accepted. Dr. Z. Liu, from Beijing University, has joined the team since August 2012 for two years. The objective of this project is to propose an efficient spatio-temporal saliency model to predict salient regions in High-Resolution (HR) videos, and fully exploit it to ease the design and improve the performance of HR video compression and retargeting applications. With the aim to overcome the drawbacks of existing saliency models, based on a multiscale region representation, the proposed model systematically realizes statistical model saliency measuring, intra-scale saliency modification, inter-scale saliency propagation and flexible incorporation of top-down information, to generate a novel saliency representation form with scalability, saliency tree, from which a multiscale saliency fusion scheme is used to derive high-quality saliency maps at various scales.

8.3. International Research Visitors

8.3.1. *Visits of International Scientists*

Dr. Zhi Liu, from Shanghai University, has been visiting the team since August 2012 for two years. His stay is funded by the FP7-PEOPLE-2011-IIF program. The funding scheme is the MC-IIF International Incoming Fellowships (IIF).

SUMO Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

ANR VACSIM: Validation of critical control-command systems by coupling simulation and formal analysis, 2011-2014, web site
Partners: EDF R&D, Dassault Systèmes, LURPA, I3S, LaBRI, and Inria SUMO.
The project aims at developing both methodological and formal contributions for the simulation and validation of control-command systems. SUMO contributes to quantitative analysis and its application to testing, monitoring of timed systems, and verification of communicating timed automata.

ANR Ctrl-Green: Autonomic management of green data centers, 2011-2014
Partners: UJF/LIG, INPT/IRIT, Inria SUMO, EOLAS, Scalagent.
This project aims at developing techniques for the automatic optimal management of reconfigurable systems in the context of data centers using discrete controller synthesis methodology applied in the synchronous paradigm.

ANR ImpRo: Implementability and Robustness of Timed Systems, 2010-2014, web site
Partners: IRCCyN, LIP6, LSV, LIAFA, LIF, and Inria SUMO.
This project addresses the issues related to the practical implementation of formal models for the design of communicating embedded systems: such models abstract many complex features or limitations of the execution environment. The modeling of time, in particular, is usually ideal, with infinitely precise clocks, instantaneous tests or mode commutations, etc. Our objective is thus to study to what extent the practical implementation of these models preserves good properties that are satisfied by idealized models. Within IMPRO, members of SUMO mainly focus on robustness issues for timed models (timed automata, timed Petri nets,...), and diagnosis.

ANR STOCH-MC: Model-Checking of Stochastic Systems using approximated algorithms, 2014-2018.
Led by SUMO.
Partners: Inria Project Team CONTRAINTES (Rocquencourt), LaBRI (Bordeaux), and LIAFA (Paris).
The aim of STOCH-MC is to perform model-checking of large stochastic systems, using controlled approximations. Two formalisms will be considered: Dynamic Bayesian Networks, which represent compactly large Markov Chains; and Markov Decision Processes, allowing non deterministic choices on top of probabilities.

8.1.2. National informal collaborations

We collaborate with Yliès Falcone (VaSCO - LIG) on the enforcement of timed properties and Tristan Le Gall (CEA) on the control of distributed systems.

We collaborate with Arnaud Sangnier (LIAFA) on the parameterized verification of probabilistic systems.

8.2. European Initiatives

8.2.1. FP7 Projects

Participant: Éric Fabre.

Univerself is a FP7 IP, with 19 partners, among which Alcatel-Lucent, Orange Labs, Thales Comunications, Telefonica, Telecom Italia as industrial partners. It lasted from Sept. 2010 to Nov. 2013. See also http://www.univerself-project.eu/ Univerself aimed at developing self-management methods for telecommunication networks, regardless of technological boundaries (wireless, wireline, services) and at providing tools for their integrability and acceptability. The focus was first on the development of network empowerment methods (NEM), that address specific needs in automating management functions, for example power tuning in SONs (Self-Organizing Networks), network and/or service diagnosis, vulnerability detection and correction, knowledge acquisition and elaboration, optimal resource usage and allocation, etc. A second set of results was on a methodology to deploy and coordinate such NEMs, through a Universal Management Framework (UMF).

8.3. International Initiatives

8.3.1. Inria Associate Teams

DISTOL (web site) is a joint project between the SUMO Team at Inria Rennes, the LogicA team at IRISA Rennes, the Chennai Mathematical Institute, the Institute of Mathematical Sciences at Chennai and the National University of Singapore.

The DISTOL project (Distributed systems, stochastic models and logics) aims at gathering researchers from Inria Rennes, two institutes in Chennai, India (CMI and IMSC) and National University of Singapore, working on formal modeling and verification of distributed systems. This project covers four main research directions. Each of these directions rely on specific and complementary competences:

- Robustness and time issues in distributed systems models (Members of SUMO consider this problem with the Chennai Mathematical Institute)

- Applications of formal models & techniques to Web Services (Members of SUMO consider this problem with the Chennai Mathematical Institute)

- Quantitative verification for distributed systems (Members of SUMO consider this problem with researchers at NUS)

- Unification of Control Theory of Distributed Systems (This part is mainly addressed by the LOGICA team in collaboration with the Institute of Mathematical Sciences)

8.3.2. Inria International Partners

8.3.2.1. Declared Inria International Partners

Éric Badouelis member of the team ALOCO (Architecture logicielle à Composants) of LIRIMA lab (Laboratoire international de recherche en informatique et mathématiques appliquées). LIRIMA is an african lab with headquarters in Yaoundé (Cameroun) partially funded by Inria. Within the team ALOCO, Éric collaborates on artifact-centric business process models.

8.3.2.2. Informal International Partners

We collaborate with Thomas Brihaye (UMONS, Brihaye) on the verification of stochastic timed systems.

We collaborated with Laurie Ricker (Mount Allison University, Canada) and Thierry Massart (ULB,Belgium) on the control of distributed systems.

8.3.3. Participation in other International Programs

Several researchers of the SUMO team are members of the LIA Informel. The Indo-French Formal Methods Lab is a CNRS International Associated Laboratory fostering the scientific collaboration between India and France in the domain of formal methods and applications to the verification of complex systems.

The research within LIA Informel focuses on theoretical foundations of games, automata, and logics, three important tools in formal methods. Members of Informel work on the verification of safety-critical systems, with an emphasis on quantitative aspects (time, cost, energy, etc.), concurrency, control, and security protocols.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

S. Akshay from IIT Bombay visited the SUMO team one week in autumn.

Luca Bernardinello, professor at the University of Milano Bicocca (Italy).

Thomas Brihaye, professor at Mons University (Belgium), spent one month in SUMO team as ISTIC (University Rennes 1) invited professor.

Georges-Edouard Kouamou, junior professor at ENSP Yaoundé (Cameroun).

Madhavan Mukund, from the Chennai Mathematical Institute, visited SUMO in May 2013 and was part of Loïc Hélouët's habilitation jury. He also stayed one week in autumn.

Laurie Ricker (Mount Allison University) visited us during for 2 weeks in March 2013.

8.4.1.1. Internships

Shibashis Guha, PhD student at IIT Delhi, spent two months in SUMO team, supervised by Nathalie Bertrand.

Baptiste Lefebvre (L3 student, ENS Ulm), was an intern from June to Aug. 2013, on the experimental evaluation of an enhanced graceful shutdown method for the OSPF routing protocol, supervised by Éric Fabre.

Raphael Struk (L3 student, ENS Rennes), did an internship supervised by Blaise Genest and Loïc Hélouët.

8. Partnerships and Cooperations

8.1. Regional Initiatives

- AGIRA project (LigéRO) *Teaching optimization project*.

8.2. National Initiatives

- Development of IBEX with Jordan Ninin and Luc Jaulin from ENSTA Bretagne, Bertrand Neveu from ENPC PariTech, and Gilles Trombettoni from Lirmm.
- Work on a conference and journal paper on optimization problems with Mohamed Siala, PhD student at LAAS, Toulouse.
- Collaboration with F. Pachet and P. Roy, Sony music, Paris.

8.3. International Initiatives

8.3.1. Inria Associate Teams

Inria Associated Team Bananas

- Partners: Inria-Lorraine, PUCV (Chili), UTFSM (Chili), Univ. Angers (LERIA), Univ. Nantes (TASC).
- Duration: 2012-2014.
- Topics: Autonomous constraint solving, SMT solvers.
- Budget: 15 KEuros per year for the project.

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

- SICS, Sweden: Work on the *global constraint catalog* and on *scalable constraints* with Mats Carlsson.
- Uppsala University, Sweden: Work on automata and dedicated filtering algorithms for some constraint patterns with the ASTRA group of Pierre Flener.
- JFLI, Japan: Work with Philippe Codognet.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Helmut Simonis (4C): work on model learning and work on learning constraints in the context of EDF, three months.

8.4.2. Visits to International Teams

- N. Beldiceanu, 4C Cork Ireland: work on *learning generic models* and work on *learning constraints in the context of EDF* with H. Simonis.
- N. Beldiceanu, Uppsala University and SICS: work on *automata and constraints* with P. Flener and J. Pearson and on *learning generic models* with M. Carlsson.
- Eric Monfroy, Univ. Austral de Chile, Valparaiso, Chile: work on autonomous search with B. Crawford and R. Soto.

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TEXMEX Project-Team

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8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR FIRE-ID

Participants: Sébastien Campion, Philippe-Henri Gosselin, Patrick Gros, Hervé Jégou.

Duration: 3 years, started in May 2012.
Partner: Xerox Research Center Europe

The FIRE-ID project considers the semantic annotation of visual content, such as photos or videos shared on social networks, or images captured by video surveillance devices or scanned documents. More specifically, the project considers the fine-grained recognition problem, where the number of classes is large and where classes are visually similar, for instance animals, products, vehicles or document forms. We also assumed that the amount of annotated data available per class for the learning stage is limited.

8.1.2. ANR Secular

Participants: Laurent Amsaleg, Teddy Furon, Benjamin Mathon, Hervé Jégou, Ewa Kijak.

Duration: 3 years, started in September 2012.
Partners: Morpho, Univ. Caen GREYC, Telecom ParisTech, Inria Rennes

Content-based retrieval systems (CBRS) need security and privacy. CBRS become the main multimedia security technology to enforce copyright laws (content monetization) or to spot illegal contents (detection of copies, paedophile images, ...) over the Internet. However, they were not designed with privacy, confidentiality and security in mind. This comes in serious conflict with their use in these new security-oriented applications. Privacy is endangered due to information leaks when correlating users, queries and the contents stored-in-the-clear in the database. It is especially the case of images containing faces which are so popular in social networks. Biometrics systems have long relied on protection techniques and anonymization processes that have never been used in the context of CBRS. The project seeks to a better understanding of how biometrics related techniques can help increasing the security levels of CBRS while not degrading their performance.

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7

Program: Eurostars

Project title: Forensic Image Identifier and Analyzer

Duration: 03/2011 - 07/2014

Coordinator: Videntifier Technologies

Other partners: Videntifier Technologies (Iceland), Forensic Pathways (UK)

Abstract: FIIA is an innovative software service for the Forensic market that automatically identifies and analyzes the content of images on web sites and seized computers. The service saves time and money, gathers better evidence, and builds stronger court cases. We are in charge of helping with the technology needed to identify the logos from terrorist organizations that are inserted in images or videos. Challenges are related to the poor resolution and small size of logos as well as to the very strict efficiency constraints that the logo detector must match.

8.2.2. Quaero

Participants: Laurent Amsaleg, Sébastien Campion, Vincent Claveau, Julien Fayolle, Guillaume Gravier, Patrick Gros, Gylfi Gudmundsson, Carryn Hayward, Hervé Jégou, Ewa Kijak, Fabienne Moreau, Christian Raymond, Pascale Sébillot.

Duration: 5 years, starting in May 2008.
Prime: Technicolor.

Quaero is a large research and applicative program in the field of multimedia description (ranging from text to speech and video) and search engines. It groups 5 application projects, a joint Core Technology Cluster developing and providing advanced technologies to the application projects, and a Corpus project in charge of providing the necessary data to develop and evaluate the technologies. The large scope of QUAERO's ambitious objectives allows it to take full advantage of Texmex's many areas of research, through its tasks on: Indexing Multimedia Objects, Term Acquisition and Recognition, Semantic Annotation, Video Segmentation, Multi-modal Video Structuring, Image and video fingerprinting.

In 2013, a key fact is the best paper award obtained by Cédric Penet at CBMI 2013.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

- Intelligent Systems Lab Amsterdam (ISLA), University van Amsterdam
- Pontifical Catholic Univeristy of Minas Gerais, Brazil
- National Institute for Informatics, Japan
- Prague Technical University, Czech Republic
- National Technical University of Athens, Greece

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Michael Rabbat

  Dates: November 2013 (1 month)

  Subject: Continuous Associative Memories

  Institution: Mc Gill University, Canada

8.4.2. Internships

- Giorgos Tolias

  Dates: October 2012–January 2013 (5 months)

  Subject: Large scale visual search

  Institution: National Technical University of Athens (Greece)

8.4.3. Visits to International Teams

- Mihir Jain

  Dates: June 2013–September 2013

  Subject: Action Recognition and Event Retrieval

  Institution: Intelligent Systems Lab Amsterdam (ISLA), University van Amsterdam

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8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR GEMOC

Participants: Benoit Combemale, Didier Vojtisek, Olivier Barais, Arnaud Blouin, Erwan Bousse, Benoit Baudry.

Heterogeneous modeling, model driven engineering, executable metamodeling, models of computation, simulation.

The ANR project **GEMOC** (French Agency for Research, Program INS 2012) focuses on a generic framework for heterogeneous software model execution and dynamic analysis. This work has the ambition to propose an innovative environment for the design of complex software-intensive systems by providing:

- a formal framework that integrates state-of-the-art in model-driven engineering (MDE) to build domain-specific modeling languages (DSMLs), and models of computation (MoC) to reason over the composition of heterogeneous concerns;
- an open-source design and modeling environment associated to a well-defined method for the definition of DSMLs, MoCs and rigorous composition of all concerns for execution and analysis purposes.

This requires addressing two major scientific issues: the design and verification of a formal framework to combine several different DSMLs relying on distinct MoCs; the design and validation of a methodology for DSMLs and MoC development. GEMOC aims at participating in the development of next generation MDE environments through a rigorous, tool-supported process for the definition of executable DSMLs and the simulation of heterogeneous models.

Project duration: 2012-2016

Triskell budget share: 253 keuros

Number of person/years: 2.2

Project Coordinator: Inria (Triskell)

Participants: ENSTA Bretagne, Inria, IRIT, I3S, Obeo, Thales

8.1.2. ANR INFRA-JVM

Participants: Johann Bourcier, Olivier Barais, Inti Gonzalez Herrera, Erwan Daubert, Walter Rudametkin Ivey.

JVM, Kevoree, Models@Runtime

INFRA-JVM is an ANR project whose goal is to design and provide a new Java Virtual Machine dedicated to pervasive environments. This project focuses on designing a Java Virtual Machine for embedded computing platform offering dynamic reconfiguration capabilities. The project focuses on the three following parts:

- Defining new mechanisms to provide component-based support for provisionning I/O and memory guarantee
- Defining languages and runtime support for efficient process scheduling on multi-core platform
- Optimizing the memory allocation on multi-core platforms.

Triskell mainly works this year on VMkit (the integration platform of the project) and Kevoree (our Component Based platform) to run Kevoree on top of VMkit.

Project duration: 2012-2015

Triskell budget share: 193 keuros

Number of person/years: 2

Project Coordinator: Université Paris 6

Participants: Université Paris 6, Université Bordeaux 1, Université Rennes 1 (Triskell), Ecole des Mines de Nantes

8.1.3. BGLE2 CONNEXION

Participants: Benoit Baudry, Arnaud Blouin, Fabien Coulon, Valéria Lelli Leitão Dantas, Nicolas Sannier.

requirement, software testing, critical system, HCI, MDE

The cluster CONNEXION (*digital command CONntrol for Nuclear EXport and renovatION*) aims to propose and validate an innovative architecture platforms suitable control systems for nuclear power plants in France and abroad. In this project the Triskell team investigates methods and tools to (i) automatically analyze and compare regulatory requirements evolutions and geographical differences; (ii) automatically generate test cases for critical interactive systems.

Project duration: 2012-2016

Triskell budget share: 515 keuros

Number of person/years: 3

Project Coordinator: EDF

Participants: Atos WorldGrid, Rolls-Royce Civil Nuclear, Corys TESS, Esterel Technologies, All4Tec, Predict, CEA, Inria, CNRS / CRAN, ENS Cachan, LIG, Telecom ParisTech

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. NeSSoS

Type: COOPERATION

Defi: Trustworthy ICT

Instrument: Network of Excellence

Objectif: Trustworthy ICT

Duration: October 2010 - March 2014

Coordinator: CNR - Consiglio Nazionale delle Ricerche (Italy)

Others partners: ATOS (Spain), ETH (Switzerland), Katholieke Universiteit Leuven (Belgium), Ludwig-Maximilians-Universitaet Muenchen (Germany), IMDEA (Spain), Inria (France), University of Duisburg-Essen (Germany), University of Malaga (Spain), University of Trento (Italy), SIEMENS (Germany), SINTEF (Norway)

See also: http://www.nessos-project.eu/

Inria contact: V. Issarny

Abstract: The Network of Excellence on Engineering Secure Future Internet Software Services and Systems (NESSoS) aims at constituting and integrating a long lasting research community on engineering secure software-based services and systems. In light of the unique security requirements the Future Internet will expose, new results will be achieved by means of an integrated research, as to improve the necessary assurance level and to address risk and cost during the software development cycle in order to prioritize and manage investments. NESSoS will also impact training and education activities in Europe to grow a new generation of skilled researchers and practitioners in the area. NESSoS will collaborate with industrial stakeholders to improve the industry best practices and support a rapid growth of software-based service systems in the Future Internet.

Three Inria EPIs are involved in NeSSoS: ARLES, CASSIS and Triskell. Triskell leads the research workpackage on design and architecture for secured future internet applications.

Triskell budget share: 100 keuros

8.2.1.2. DIVERSIFY

Type: COOPERATION

Defi: Foundation of Collaborative Adaptive Systems

Instrument: Specific Targeted Research Project

Objectif: NC

Duration: February 2013 - January 2016

Coordinator: Inria

Partner: SINTEF (Norway), Trinity College Dublin (Ireland), Université de Rennes 1 (France)

See also: http://www.diversify-project.eu/

Inria contact: Benoît Baudry

Abstract: DIVERSIFY aims at favoring spontaneous diversification in software systems in order to increase their adaptive capacities. This objective is founded on three observations: software has to constantly evolve to face unpredictable changes in its requirements, execution environment or to respond to failure (bugs, attacks, etc.); the emergence and maintenance of high levels of diversity are essential to provide adaptive capacities to many forms of complex systems, ranging from ecological and biological systems to social and economical systems; diversity levels tend to be very low in software systems.

DIVERSIFY explores how the biological evolutionary mechanisms, which sustain high levels of bio-diversity in ecosystems (speciation, phenotypic plasticity and natural selection) can be translated in software evolution principles. In this work, we consider evolution as a driver for diversity as a means to increase resilience in software systems. In particular, we are inspired by bipartite ecological relationships to investigate the automatic diversification of the server side of a client-server architecture. This type of software diversity aims at mitigating the risks of software monoculture. The consortium gathers researchers from the software-intensive, distributed systems and the ecology areas in order to transfer ecological concepts and processes as software design principles.

Triskell budget share: 500 keuros

8.2.1.3. HEADS

Type: COOPERATION

Defi:

Instrument: Specific Targeted Research Project

Objectif: NC

Duration: October 2013 - September 2016

Coordinator :SINTEF (Norway)

Partner: SINTEF (Norway), M2MZone (Ireland), TellU (Norway), SoftwareAG (Germany), ATC (Greece), Inria (France)

Inria contact: Benoît Baudry

Abstract: The idea of the HEADS project is to leverage model-driven software engineering and generative programming techniques to provide a new integrated software engineering approach which allow advanced exploitation the full range of diversity and specificity of the future computing continuum. The goal is to empower the software and services industry to better take advantage of the opportunities of the future computing continuum and to effectively provide new innovative services that are seamlessly integrated to the physical world making them more pervasive, more robust, more reactive and closer (physically, socially, emotionally, etc.) to their users.

Triskell budget share: 400 keuros

8.2.2. Collaborations in European Programs, except FP7

8.2.2.1. Marie-Curie Relate

Program: Marie Curie

Project acronym: Relate

Project title:Trans-European Research Training Network on Engineering and Provisioning of Service-Based Cloud Applications

Duration: February 2011 - January 2015

Triskell budget share: 730 keuros

Coordinator: Karlsruhe Institute of Technology

Other partners: Université de Rennes, IRISA (France); King's College, (UK); South East European Research Center, SEERC (Greece); Charles University (Czech Republic); CAS Software (Germany); Singular Logic (Greece)

Abstract: The RELATE Initial Training Network aims to establish a network of international academic and industrial partners for a joint research training effort in the area of engineering and provisioning service-based cloud applications. The training is intended to not only shape high-level academic researchers, but also educate next generation experts and innovators in the European software industry. Through an integrative and multidisciplinary research approach, RELATE aims to promote the advancement of the state of the art in the related areas of model-driven engineering and formal methods, service-based mash-ups and application integration, security, performance, and trust in service-based cloud applications, and quality management and business model innovation.

8.2.2.2. MERGE

Program: ITEA2

Project acronym: Merge

Project title:Trans-European Research Training Network on Engineering and Provisioning of Service-Based Cloud Applications

Duration: December 2012 - December 2015

Triskell budget share: 250 keuros

Coordinator: Thales Research and Technology

Other partners: Thales Global Services, Thales Communications and Security, OBEO, ALL4TEC, Onera, Inria, Université Paris VI, Codenomicon, STUK - Radiation and Nuclear Safety Authority, POHTO nSense Oy, University of Oulu, University of Jyvaskyla, Space Applications Services NV, Melexis, E2S, Katholieke Universiteit Leuven

Abstract: MERgE stands for "Multi-Concerns Interactions System Engineering". Within the "Engineering support" theme of ITEA2 roadmap, the purpose of this project is to develop and demonstrate innovative concepts and design tools addressing in combination the "Safety" and "Security" concerns, targeting the elaboration of effective architectural solutions. MERgE will provide tools and solutions for combining safety and security concerns in systems development in a holistic way. It will provide academically solid and practice proven solutions and models for system developers and system owners to tackle the challenges of designing seamless optimal cost effective safe and secure solutions conformant to the model driven engineering paradigm. This will be done by tightly integrating the following paradigms: requirement engineering, safety, security and risk management in an over-all design process which is supported by adequate tools and methods. MERgE aims to bring a system engineering solution for Combined Safe & Secure system design. The main technical innovation of the project is the application of state of the art design tools tailorisation capabilities and "multi concern engineering" core technologies to the issue of interactions of "Safety" and "Security" concerns as well as other concerns like "Performance" or "Timing" in the design process.

8.3. International Initiatives

8.3.1. Participation In other International Programs

8.3.1.1. TAAS

Program: Foundation Araucaria Inria Brazil

Title: Software testing for cloud computing

Inria principal investigator: Gerson SUNYE

International Partner (Institution - Laboratory - Researcher):

Federal University of Parana (Brazil) - Gerson SUNYE

Duration: Jul 2011 - Jun 2013

8.3.1.2. SPLIT

Program: International joint supervision of PhD agreement

Title: Aspect-oriented modeling and software product line

Inria principal investigator: Jean-Marc JEZEQUEL

International Partner (Institution - Laboratory - Researcher):

University of Luxembourg (Luxembourg) - Jean-Marc JEZEQUEL

Duration: Apr 2010 - Mar 2013

See also: http://www.fnr.lu/fr/Research-Programmes/Research-Programmes/Projects/Combine-Software-Product-Line-and-Aspect-Oriented-Software-Development-SPLIT

Combine Software Product Line and Aspect-Oriented Software Development - SPLIT

8.3.1.3. MBSAR

Program: CNRS PICS

Title: Model-Based Security Analysis at Runtime (MBSAR)

Inria principal investigator: Benoit Combemale

International Partner (Institution - Laboratory - Researcher):

Colorado State University (USA) - Software Assurance Lab - Robert B. France

Duration: Jan 2013 - Dec 2015

See also: http://gemoc.org/mbsar/

MBSAR develop model-based techniques for runtime analysis and enforcement of security policies in adaptive software systems.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

Ioannis Kavvouras

Subject: Spontaneous diversification in software components

Date: from Mar 2013 until Jul 2013

Institution: Université Nationale Capodistrienne d'Athènes (Greece)

Marianela Ciolfi Felice

Subject: Draw your Products! A Model-based Approach

Date: from Mar 2013 until Aug 2013

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

Wuliang Sun

Subject: Synthesis of Feature-based Model Templates

Date: from Jun 2013 until Jul 2013

Institution: Colorado State University (United States)

8.4.2. Visits to International Teams

Participant: Arnaud Blouin.

Date: May 2013

Visited Institution: the laboratory for research on technology for ecommerce (LATECE) at the University of Québec at Montréal (UQÀM), Canada

8.4.3. Inria International Chair

Prof. Robert B. France [11] was granted by an Inria international chair for the period 2013-2017. Prof. France collaborate intensively with many members of the Triskell team on various joint work, e.g., the Familiar project and the GEMOC initiative. The Inria International Chair will allow Prof. France to make different long visits in the team along the period.

8.4.4. International initiative GEMOC

International initiative GEMOC

The GEMOC initiative (cf. http://www.gemoc.org) is an open and international initiative launched in 2013 that coordinate research partners worldwide to develop breakthrough software language engineering (SLE) approaches that support global software engineering through the use of multiple domain-specific languages. GEMOC members aim to provide effective SLE solutions to problems associated with the design and implementation of collaborative, interoperable and composable modeling languages.

The GEMOC initiative aims to provide a framework that facilitates collaborative work on the challenges of using of multiple domain-specific languages in software development projects. The framework consists of mechanisms for coordinating the work of members, and for disseminating research results and other related information on GEMOC activities. The framework also provides the required infrastructure for sharing artifacts produced by members, including publications, case studies, and tools.

The governance of the GEMOC initiative is ensured by the Advisory Board. The role of the Advisory Board is to coordinate the GEMOC work and to ensure proper dissemination of work products and information about GEMOC events (e.g., meetings, workshops).

Benoit Combemale is the co-founder and currently acts as principal coordinator of the GEMOC initiative. Benoit Combemale and Jean-Marc Jézéquel are part of the Advisory Board, and 9 Triskell members are part of the GEMOC initiative.

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[11]Colorado State University, USA. See http://www.cs.colostate.edu/~france/

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Biogenouest

The VisAGeS team and the Neurinfo platform integrated the Biogenouest "Groupement d'Intérêt Scientifique (GIS)" in 2012.

Biogenouest is a Western France life science and environment core facility network. Research programmes are undertaken in the fields of Marine biology, Agriculture/Food-processing, Human health, and Bioinformatics. Set up in keeping with the inter-regional principle of complementarity, Biogenouest coordinates over twenty technological core facilities in both the Brittany and Pays de la Loire regions.

8.1.2. COREC projects

COREC is the "COmité de REcherche Clinique" of the University Hospital of Rennes. This comity proposes an annual project funding in the limit of 30k€ per project. In 2012, the Neurinfo platform as an incitative action for clinical research project emergence accompanied the COREC call by financially supporting the imaging part of the projects up to 50 MRI hours, ie 30k€. Two projects were selected by the COREC. The MALTA project led by radiologist Jean-Christophe Ferré will compare the ability of functional BOLD MRI and perfusion ASL MRI to detect language areas in patients with brain tumor.

8.1.3. Projet CRITT Santé Bretagne : AfaCorVis3D

Participants: Elise Bannier, Isabelle Corouge, Christian Barillot.

duration: 12 months from November 2011

A research projet in fMRI involving 3D visual stimulation was performed to try and differentiate areas activated by 2D versus 3D visualisation, whether static or dynamic. The task was evaluated on 10 volunteers in the context of the Master Research Projet of Guillaume Koch. Areas activated specifically by 3D visualisation were extracted.

8.1.4. Défis Scientifiques Emergents - Université de Rennes I

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

duration: 22 months from March 2012 (end: December 31, 2013)

The ASLDEM project was partially funded the University of Rennes 1 "Défis Scientifiques Emergents" grant (7000 euros).

8.1.5. Fondation de l'Avenir - Depression, suicide and fMRI

Participants: Elise Bannier, Isabelle Corouge, Jean-Christophe Ferré, Christian Barillot.

duration: 12 months from November 2012

In collaboration with EA 4712 "Comportement et Noyaux Gris Centraux" of the University of Rennes I, a complementary funding (20 000€) was obtained to support an ongoing fMRI research project on emotions, impulsivity and suicide. The study protocol and the fMRI task was finalized. Inclusions will start early 2013.

8.1.6. Fondation de l'Avenir - Stroke, rehabilitation and fMRI

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

duration: 12 months from November 2012

A complementary funding (20 000€) was obtained to support a new research project on rehabilation of stroke patients. The fMRI protocol was setup, the task developed and validation on volunteers is ongoing. Patient inclusions will start in spring 2013.

8.1.7. *Fondation Planiol*

Participants: Elise Bannier, Hélène Raoult, Jean-Yves Gauvrit.

duration: 12 months from November 2012

In the context of a neurovascular imaging research study, funding (13500€) was obtained to perform a phantom study on test objects representing carotid stenosis, with a circulating flow. This project will be performed as part of a collaboration with Dr Cavaro Ménard - Angers (LISA), Dr Langevin - Compiègne (UTC) and Pr Saint Jalmes - PRISM (UR1).

8.2. National Initiatives

8.2.1. *ANR*

8.2.1.1. *ANR "Neurological and Psychiatric diseases" NUCLEIPARK*
Participants: Christian Barillot, Sylvain Prima, Juan Francisco Garamendi Bragado.

NucleiPark project: In the context of the ANR-09-MNPS-016 Nucleipark project we develop a pipeline for detecting shape changes in Parkinson and Paralysis Supranuclear Progressive (PSP) diseases.The pipeline is based on the previous work of Benoit Combès et al. [58]. The pipeline was first validated on controlled synthetic data. For Parkinson disease, a total of 16 patients and 11 healthy controls were evaluated. The structuctures analyzed were: PPN, GPe, GPi, Caudatge, Putamen, SN, STN, RN. Differences (uncorrected P <0.001) were found in the right putamen and caudate structures. And slight difference (uncorrected P<0.05) in the right GPe. No significant correlation was found in PPN, GPi, SN, STN, and RN structures. In the case of PSP disease, a total of 10 patients and 11 healthy controls were evaluated. the structures analyzed were: PPN, GPe, GPi, Caudate, Putamen, SN, STN, RN. Differences (uncorrected P <0.001) were found in the left caudate structure. No significant correlation was found in PPN,GPe, GPi, Putamen, SN, STN, and RN structures.

In the context of this project, we propose a statistical data analysis pipeline that uses the apparent diffusion coefficient (ADC) as biomarker. The ADC is computed considering the diffusion weighted signal as a scalar field on a 5-D manifold. This consideration allows to keep the information about direction of the ADC. We have tested the proposed pipeline on synthetic dataset with promising results. Other contributions were the implementation and minimization, in the 5-D non-euclidean space, of the total variation (in its dual formulation) inpainting problem as interpolation method used in the statistical pipeline.

8.2.1.2. *ANR Cosinus VIP*
Participants: Fang Cao, Olivier Commowick, Christian Barillot.

VIP is collaborative project supported by ANR "Conception and Simulation"; it was accepted in 2009 (around 1 million euros). VIP aims at building a computing environment enabling multi-modality, multi-organ and dynamic (4D) medical image simulation, using GRID infrastructure. The goal is to integrate proven simulation software of the four main imaging modalities (MRI, US, PET and X-Ray/CT), and to cope interoperability challenges among simulators. The partners are CREATIS in Lyon (main contractor, Principal Investigator: Tristan Glatard), UNS-I3S in Nice, CEA-LETI in Grenoble and MAAT-G Maat G, a spanish company. The role of VISAGES in this project concerns primarily Task 1.1 and Task 3.3, focusing respectively on ontologies development and application to multiple sclerosis images simulation. This grant serves as support for the positions of Olivier Luong (PhD student) and Germain Forestier (post-doc).

8.2.1.3. *AINSI Inria joint project*
Participants: Christian Barillot, Isabelle Corouge, Pierre Maurel, Jean-Christophe Ferré, Elise Bannier, Camille Maumet.

We have been involved in a 2-year Inria ARC project AINSI (http://thalie.ujf-grenoble.fr/ainsi). AINSI stands for "Modeles statistiques pour l'Assimilation d'Informations de Neuroimagerie fonctionnelle et de perfuSIon cerebrale". The goal is to propose an innovative statistically well-based solution to the joint determination of neural activity and brain vascularization by combining BOLD constrast images obtained in functional MRI and quantitative parametric images (Arterial Spin Labelling: ASL). The partners involved are the Mistiss project from Inria in Grenoble (Lead F. Forbes) and Parietal in Saclay, the INSERM Unit U594 (Grenoble Institute of Neuroscience) and the LNAO laboratory from CEA NeuroSpin.

8.2.1.4. TRANSLATE-MS-REPAIR

Participants: Fang Cao, Laurence Catanese, Olivier Commowick, Isabelle Corouge, Jean-Christophe Ferré, Elise Bannier, Gilles Edan, Christian Barillot.

It is now commonly admitted that MS is not only an inflammatory disease but a neurodegenerative disease as well. This project is devoted to show that the olesoxime molecule is not only neuroprotective, but it has the ability to promote the maturation of oligodendrocyte progenitor cells (OPCs) into myelinating oligodendrocytes. However, before considering a large-scale clinical trial to assess efficacy. An important aspect is that to date, no treatment for neuroprotection / remyelination has reached the stage of clinical proof of concept that aims Trophos company who is leading this project. It appears that the best criteria for assessing neuroprotective/remyelinating effect of the drug candidate, are MRI criteria. However, these imaging criteria have not yet been validated for use in multicentre trials - so we will also check the feasibility of such measures under this condition. In addition to Trophos company, the partners of this project are AP-HM/CNRSCEMEREM-CRMBM, CHU Rennes, CHU Reims, and Inria-VISAGES.

8.2.2. Competitivity Clusters

8.2.2.1. The HEMISFER Project

Participants: Elise Bannier, Isabelle Bonan, Isabelle Corouge, Jean-Christophe Ferré, Jean-Yves Gauvrit, Pierre Maurel, Lorraine Perronnet, Christian Barillot.

The HEMISFER project ("Hybrid Eeg-MrI and Simultaneous neuro-FEedback for brain Rehabilitation") will be conducted at Inria Rennes with the support of the Cluster of Excellence "CominLabs" [1]. The goal of HEMISFER is to make full use of the neurofeedback paradigm in the context of rehabilitation and psychiatric disorders. The major breakthrough will come from the use of a coupling model associating functional and metabolic information from Magnetic Resonance Imaging (fMRI) to Electro-encephalography (EEG) to "enhance" the neurofeedback protocol. We propose to combine advanced instrumental devices (Hybrid EEG and MRI platforms), with new man-machine interface paradigms (Brain computer interface and serious gaming) and new computational models (source separation, sparse representations and machine learning) to provide novel therapeutic and neuro-rehabilitation paradigms in some of the major neurological and psychiatric disorders of the developmental and the aging brain (stroke, attention-deficit disorder, language disorders, treatment-resistant mood disorders, . . .). This project will be conducted with the HYBRID and PANAMA Teams from Inria Rennes, the EA 4712 team from University of Rennes I and the ATHENA team from Inria Sophia-Antipolis. This work will benefit from the research 3T MRI and MRI-compatible EEG systems provided by the NeurInfo in-vivo neuroimaging platform on which these new research protocols will be set up. A budget of 500keuros will be provided by the CominLabs cluster in the next 3 years to support this project (through experimental designs, PhDs, Post-docs and Expert Engineers).

8.2.2.2. France Life Imaging (FLI)

Participants: Christian Barillot, Olivier Commowick, Michael Kain.

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[1]https://iww.inria.fr/cominlabs-newsletter/april-2013-four-projects-selected/#hemisfer

France Life Imaging (FLI) is a proposed large-scale research infrastructure project aimed at establishing a coordinated and harmonized network of biomedical imaging in France. This project was recently selected by the call "Investissements d'Avenir - Infrastructure en Biologie et Santé". One node of this project is the node Information Analysis and Management (IAM), a transversal node build by a consortium of teams that will contribute to the construction of a network for data storage and information processing. Instead of building yet other dedicated facilities, the IAM node will use already existing data storage and information processing facilities (LaTIM Brest; CREATIS Lyon; CIC-IT Nancy; Visages U746 Inria Rennes; CATI CEA Saclay; LSIIT/ICube Strasbourg) that will increase their capacities for the FLI infrastructure. Inter-connections and access to services will be achieved through a dedicated software platform that will be developed based on the expertise gained through successful existing developments. The IAM node has several goals. It aims first at building a versatile facility for data management that will inter-connect the data production sites and data processing for which state-of-the-art solutions, hardware and software, will be available to infrastructure users. Modular solutions are preferred to accommodate the large variety of modalities acquisitions, scientific problems, data size, and adapted for future challenges. Second, it aims at offering the latest development that will be made available to image processing research teams. The team VISAGES fulfills multiple roles in this nation-wide project. Christian Barillot is the chair of the node IAM, Olivier Commowick is participating in the working group workflow and image processing and Michael Kain the technical manager. Apart from the team members, software solutions like medInria and Shanoir will be part of the final software platform.

8.2.2.3. OFSEP

Participants: Justine Guillaumont, Elise Bannier, Christian Barillot, Olivier Commowick, Gilles Edan, Isabelle Corouge, Jean-Christophe Ferré, Michael Kain.

The French Observatory of Multiple Sclerosis (OFSEP) is one of 10 projects selected in January 2011 in response to the call for proposal in the "Investissements d'Avenir - Cohorts 2010" program launched by the French Government. It allows support from the National Agency for Research (ANR) of approximately € 10 million for 10 years . It is coordinated by the Department of Neurology at the Neurological Hospital Pierre Wertheimer in Lyon (Professor Christian Confavreux), and it is supported by the EDMUS Foundation against multiple sclerosis, the University Claude Bernard Lyon 1 and the Hospices Civils de Lyon. OFSEP is based on a network of neurologists and radiologists distributed throughout the French territory and linked to 61 centers. OFSEP national cohort includes more than 35,000 people with Multiple Sclerosis, approximately half of the patients residing in France. The generalization of longitudinal monitoring and systematic association of clinical data and neuroimaging data is one of the objectives of OFSEP in order to improve the quality , efficiency and safety of care and promote clinical, basic and translational research in MS. For the concern of data management, the Shanoir platform of Inria has been retained to manage the imaging data of the National OFSEP cohort in multiple sclerosis.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. EuroBioimaging

> Type: CAPACITIES
>
> Defi: Provide access and training in imaging technologies, and share the best practice and image data in order to make Euro-BioImaging an engine that will drive European innovation in imaging research and technologies
>
> Instrument: Combination of COLLABORATIVE PROJECTS and COORDINATION and SUPPORT ACTIONS
>
> Objectif: Euro-BioImaging is a large-scale pan-European research infrastructure project on the European Strategy Forum on Research Infrastructures (ESFRI) Roadmap.
>
> Duration: December 2010 - November 2013
>
> Coordinators: Jan Ellenberg (EMBL) and Oliver Speck (University of Magdeburg)

Partner: EMBL (Germany); Erasmus Medical Center (Netherlands) for WG11

Inria contact: Ch. Barillot X. Pennec

Abstract: Euro-BioImaging is a pan-European infrastructure project whose mission is to build a distributed imaging infrastructure across Europe that will provide open access to innovative biological and medical imaging technologies for European researchers. The project is funded by the EU and currently the consortium is finalizing the basic principles for the operation of future Euro-BioImaging organisation.

Euro-BioImaging will be governed by representatives of the European countries that will join Euro-BioImaging (Euro-BioImaging member states).

The infrastructure established by Euro-BioImaging will consist of a set of geographically distributed but strongly interlinked imaging facilities (Euro-BioImaging Nodes), which will be selected among the leading European imaging facilities based on an independent evaluation process.

Inria and the Visages team is involved through the FLI national infrastructure and contributes to the WG11 Working Group on Data Storage and Analysis. This WG performs a series of tasks to define a European Biomedical Imaging Data Storage and Analysis infrastructure plan for the construction phase.

8.3.2. Collaborations in European Programs, except FP7

Program: COST

Project acronym: AID (oc-2010-2-8615)

Project title: Arterial spin labelling Initiative in Dementia

Acceptation date: 18/05/2011

Coordinator: X. Golay, UCL, London, UK

Other partners: Ghent University (BE), Liege University (BE), Hospital Cantonal de Geneve (CH), Fraunhofer MEVIS (D), Freiburg University (D), Max Planck Institute for Human Cognitive & Brain Sciences (D), Glostrup Hospital (DK), Hospital Santa Creu I Sant Pau (ES), Universidad Rey Juan Carlos (ES), University of Narvarra (ES), INSERM U836 Grenoble (FR), University of Rennes I (FR), Centro San Giovanni di Dio - Fatebenefratelli (IT), Fondazione Instituto Neurologico Besta (IT), Leiden University Medical Center (NL), UMC Utrecht (NL), VU University Medical Centre (NL), Instituto Superior Técnico (PT), University of Porto (PT), Lund University Hospital (SE), Uppsala University Hospital (SE), Skane University Hospital (SE), Bogazici University (TR), King's College London (UK), University College London (UK), University of Nottingham (UK), University of Oxford (UK)

Abstract: Dementia is a major clinical challenge with care costs approaching 1% of global GDP. Recent estimates suggest that delaying disease onset by 5 years would halve its prevalence. As new disease-modifying treatments will be specific to causative diseases, expensive and bear significant side effects, early diagnosis of dementia will be essential. Current diagnostic criteria include the use of image-based biomarkers using radiotracers. The AID Action aims at coordinating the development of an alternative and cost-effective tool based on an MRI technique, Arterial Spin Labelling (ASL), to obtain reproducible brain perfusion measurements in dementia patients by bringing together scientists and clinicians from across Europe through the flexibility of the COST mechanism. The scientific program is centered around four work packages and three workgroups aiming at developing standards, improving the reliability of the technique and as establishing it as a possible clinical trial outcome measure. Development of MRI methods, post-processing tools, protocols of cross-validation, statistical analyses and launch of clinical and comparative studies will be undertaken. The main benefit of this Action will be to provide a cost-effective alternative to radiotracer-based biomarkers, and help care providers throughout Europe balancing the need for early diagnosis of dementia with the necessary healthcare cost containment.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. BARBANT

Title: Boston and Rennes, Brain image Analysis Team

Inria principal investigator: Christian Barillot

International Partner:

> Children's Hospital Boston - Harvard Medical School (United States) - Computational Radiology Laboratory - Christian Barillot

Duration: 2012 - 2014

See also: https://team.inria.fr/barbant/

This associated team is shared between Inria Visages team and the Computational Radiology Laboratory of the Children?s hospital Boston at Harvard Medical School. We will address the topic of better understanding the behavior and evolution of neurological pathologies (such as neurodevelopmental delay or multiple sclerosis) at the organ and local level, and the modeling of normal and pathological groups of individuals (cohorts) from image descriptors. At term, this project will allow to introduce objective figures to correlate qualitative and quantitative phenotypic markers coming from the clinic and image analysis, mostly at the early stage of the pathologies. This will allow for the selection or adaptation of the treatment for patients at an early stage of the disease.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Within the BARBANT associate team, P. Simon K. Warfield, Dr. Benoit Scherrer and Dr. Maxime Taquet (Computational Radiology Laboratory, Harvard Medical School) visited us for a workshop on multiple sclerosis and diffusion image processing.

8.5.2. Visits to International Teams

- Several members of the Visages team (Christian Barillot, Olivier Commowick, Renaud Hédouin, Yogesh Karpate) visited the Computational Radiology Laboratory (Harvard Medical School) for an associate team (BARBANT) meeting to discuss new research topics.
- Christian Barillot visited the Information and Communications department at the Graduate School of Information Science of the Nagoya University, Japan in May 2013