



RESEARCH CENTER
Rennes - Bretagne-Atlantique

FIELD

Activity Report 2012

Section Partnerships and Cooperations

Edition: 2013-04-24

ALGORITHMICS, PROGRAMMING, SOFTWARE AND ARCHITECTURE

| | |
|--------------------------|----|
| 1. ALF Project-Team | 4 |
| 2. CAIRN Project-Team | 7 |
| 3. CELTIQUE Project-Team | 14 |
| 4. ESPRESSO Project-Team | 16 |
| 5. S4 Project-Team | 20 |
| 6. TASC Project-Team | 22 |
| 7. VERTECS Project-Team | 23 |

APPLIED MATHEMATICS, COMPUTATION AND SIMULATION

| | |
|-----------------------|----|
| 8. ASPI Project-Team | 25 |
| 9. I4S Team | 26 |
| 10. IPSO Project-Team | 29 |

COMPUTATIONAL SCIENCES FOR BIOLOGY, MEDICINE AND THE ENVIRONMENT

| | |
|-----------------------------|----|
| 11. DYLISS Team | 31 |
| 12. FLUMINANCE Project-Team | 36 |
| 13. GENSCALE Team | 38 |
| 14. SAGE Project-Team | 42 |
| 15. SERPICO Team | 48 |
| 16. VISAGES Project-Team | 51 |

NETWORKS, SYSTEMS AND SERVICES, DISTRIBUTED COMPUTING

| | |
|-----------------------------|----|
| 17. ACES Project-Team | 55 |
| 18. ASAP Project-Team | 56 |
| 19. ASCOLA Project-Team | 60 |
| 20. ATLANMOD Team | 64 |
| 21. CIDRE Project-Team | 68 |
| 22. DIONYSOS Project-Team | 73 |
| 23. DISTRIBCOM Project-Team | 77 |
| 24. KERDATA Project-Team | 82 |
| 25. MYRIADS Project-Team | 85 |
| 26. TRISKELL Project-Team | 94 |

PERCEPTION, COGNITION, INTERACTION

| | |
|---------------------------------------|-----|
| 27. DREAM Project-Team (section vide) | 100 |
| 28. LAGADIC Project-Team | 101 |
| 29. METISS Project-Team | 104 |
| 30. MIMETIC Team | 107 |
| 31. SIROCCO Project-Team | 110 |
| 32. TEXMEX Project-Team | 112 |
| 33. VR4I Team | 115 |

ALF Project-Team

8. Partnerships and Cooperations

8.1. European Initiatives

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

Participants: Pierre Michaud, Luis Germán García Morales, Nathanaël Prémillieu, Erven Rohou, André Seznec, Bharath Narasimha Swamy, Ricardo Andrés Velásquez, Arthur Pérais, Surya Narayanan, Arjun Suresh, Sajith Kalathingal, Kamil Kedzierski.

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/dal>.

8.1.2. 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.

8.1.3. COST Action TACLe - Timing Analysis on Code-Level 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 is indispensable to ascertain whether these requirements are met. However, recent developments in hardware, especially multicore processors, and software organization make the analysis increasingly harder, thus challenging the evolution of timing analysis techniques. Principles for building "timing-composable" embedded systems are needed to make timing analysis tractable in the future. The furthering and consolidation of those principles require increased contacts within the timing analysis community as well as with the neighboring communities that deal with other forms of analysis, such as model checking and type inference, and with computer architectures and compilers. The goal of this COST Action (http://www.cost.eu/domains_actions/ict/Actions/IC1202) is to gather these forces in order to develop industrial strength code-level timing analysis techniques for future generation embedded systems.

Twelve countries are currently involved in this COST action.

8.2. Regional Initiative

8.2.1. Brittany region fellowship

Participants: Ricardo Andrés Velásquez, Pierre Michaud, André Seznec.

The Brittany region is funding a Ph.D. fellowship for Ricardo Velasquez on the topic “Fast hybrid multicore architecture simulation”.

8.3. National Initiatives

8.3.1. ANR PetaQCD 01-2009/10-2012

Participants: Junjie Lai, André Seznec.

Simulation of Lattice QCD is a challenging computational problem that requires very high performance exceeding sustained Petaflops/s. The ANR PetaQCD project combines research groups from computer science, physics and two SMEs (CAPS Entreprise, Kerlabs) to address the challenges of the design of LQCD oriented supercomputer.

8.3.2. 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.

8.3.3. Large Scale Initiative: Large scale multicore virtualization for performance scaling and portability

Participant: Erven Rohou.

An Inria Large Scale Initiative (Action d’Envergure) has been submitted and approved. 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.

8.3.4. ADT PADRONE 2012-2014

Participants: Erven Rohou, 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 re-optimization 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).

8.4. International Initiative

8.4.1. PHC Imhotep (Egypt): Code obfuscation through JIT compilation, Jan 2012 – Dec 2013

Participant: Erven Rohou.

Collaboration with Pr Ahmed El-Mahdy, Egypt-Japan University for Science and Technology (Alexandria, Egypt)

This project proposes to leverage 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 hopeless. A strong random number generator will guarantee that generated code is not reproducible – though the functionality is the same. Performance will not be sacrificed thanks to multi-core architectures: the JIT runs on separate cores, overlapping with the execution of the application.

CAIRN Project-Team

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. 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: Fmextiles

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.

7.1.2. 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.

7.1.3. 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 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

Hervé Yviquel spent 4 months in the group of Jarmo Takala at Tampere University of Technology, Finland, from March.

7.2. National Initiatives

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

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. See <http://www2.lirmm.fr/~w3mic/SOCSIP/index.php>. CAIRN is the leader of the group on reconfigurable architectures.
- 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

7.2.1. ANR Blanc - PAVOIS (2012–2016)

Participants: Arnaud Tisserand, Emmanuel Casseau, Romuald Rocher, Philippe Quémerais, Jérémie Métaire.

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 and ASIC circuits. For more details see <http://pavois.irisa.fr>.

7.2.2. 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.

7.2.3. 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 (CAIRN and 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.

7.2.4. ANR Ingénierie Numérique et Sécurité - ARDyT (2011-2015)

Participants: Sébastien Pillement, Arnaud Tisserand, 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>.

7.2.5. ANR Ingénierie Numérique et Sécurité - COMPA (2011-2015)

Participants: Emmanuel Casseau, Steven Derrien, Sébastien Pillement.

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, Modae Technologies and Texas Instruments. The goal of the project is to design adaptive multiprocessor embedded systems from dataflow models. Reconfigurable video coding (RVC) standard will be targeted as application use case. We will then more specifically focus on the use of the portable and platform-independent RVC-CAL language to describe the applications. We will propose transformations in order to refine, optimize and translate the application model into software and hardware components. Task mapping, instructions and processor allocation, and constrained scheduling will also be investigated for runtime execution and reconfiguration.

7.2.6. ANR Ingénierie Numérique et Sécurité - DEFIS (2011-2015)

Participants: Olivier Sentieys, Daniel Menard, 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, Inpixon. 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>.

7.2.7. 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>.

7.2.8. S2S4HLS

Participants: Emmanuel Casseau, Steven Derrien, Daniel Menard, Olivier Sentieys, Antoine Morvan, Chenglong Xiao, Jean-Charles Naud.

NANO2012 Program - S2S4HLS (2008-2012)

High-level synthesis (HLS) tools start to be used for industrial designs. HLS is analogous to software compilation transposed to the hardware domain. From an algorithmic behavior of the specification, HLS tools automate the design process and generate a register transfer level RTL architecture taking account of user-specified constraints. However, design performance still depends on designer's skill to write the appropriate source code. The S2S4HLS (Source-to-Source for High-Level Synthesis) project intends to process source code transformations to guide synthesis hence leading to more efficient designs, and aims at providing a toolbox for automatic C code source-to-source transformations. The project is focused on three complementary goals to push the limits of existing HLS tools: loop transformations for performance optimization and a better resource usage, automatic floating-point to fixed-point conversion and synthesis of multi-mode architectures. S2S4HLS is organized into three sub-projects targeting these three objectives. The project is in close collaboration with STMicroelectronics and Comsys team at Inria Rhône-Alpes, within the overall Inria-ST partnership agreement. It is financed by the Ministry of Industry in the Nano2012 program. CAIRN is responsible of the project and involved in the three workpackages.

7.2.9. NANO2012 Program - RecMotifs (2008-2012)

Participants: François Charot, Antoine Floc'h, Christophe Wolinski.

The RecMotifs project aims at the generation of application specific extensions targeting the STxP70 processor from STMicroelectronics. CAIRN will study advanced technologies algorithms for graph matching and graph merging together with constraints programming methods. The project is in close collaboration with STMicroelectronics within the overall Inria-ST partnership agreement. It is financed by the Ministry of Industry in the Nano2012 program.

7.2.10. ANR Architectures du Futur Open-People (2009-2012)

Participants: Daniel Chillet, Robin Bonamy, Olivier Sentieys.

The Open-People (Open Power and Energy Optimization PLatform and Estimator) project aims at defining a complete platform for power estimation and optimization. The platform will be composed of hardware boards to support measurements for the applications. End-users will be able to upload their applications through a web portal, and to control the power measurements of the execution of their applications on a specific electronic board. The Open-People project will also propose a complete power component model library which allows end-users to estimate the power consumption of some parts of the applications without making measurements. This will allow to quickly evaluate the different design choices regarding the power consumption. Finally, through the web portal <http://www.open-people.fr>, Open-People will propose software tools to apply power optimizations. In this project, CAIRN team will develop power model for FPGA components using dynamic reconfiguration. Open-People involves LabSticc (Lorient), Trio (Nancy), CAIRN (Rennes/Lannion) and Dart (Lille/Valenciennes) teams from Inria, Leat at Nice, Thales (Colombes) and InPixal (Rennes). CAIRN is in charge of power models and optimization for reconfigurable architectures.

7.2.11. 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.

7.3. International Initiatives

7.3.1. Inria Associate Team LRS

Title: Loop unRolling Stones: compiling in the polyhedral model

Inria principal investigator: Steven Derrien

International Partner (Institution - Laboratory - Researcher):

Colorado State University (United States) - Mélange Group

Duration: 2010 - 2012

See also: <http://www.irisa.fr/cosi/HOMEPAGE/Derrien/EA-2010/LRS.htm>

The goal of the team is twofold: i) Propose new methodologies and algorithms to tackle some of the open problems in automatic parallelization and high level hardware synthesis from nested loop specifications. In particular, we would like to address the problem of parallelization of complex bioinformatics algorithms based of sophisticated dynamic programming algorithms, for which we would like to propose efficient parallelization schemes for both FPGAs (Field Programmable Gate Arrays) and GPUs (Graphical Processing Units). ii) Provide a common open software infrastructure based on (modern/cutting edge) software engineering techniques (Model Driven Software Development) so as to help researchers prototyping new ideas and concept in the domain of optimizing compilers. Our goal being to be able to make our in-house software completely interoperable.

7.3.2. Inria 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

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

University of Adelaide (Australia), Arithmetic operators

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

7.3.3. 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. Gabriel Caffarena (University CEU-San Pablo, Madrid) for one month in August-September.

Prof. Maciej Ciesielski (University of Massachusetts, VLSI CAD Laboratory, USA) for one month in June-July.

Dr Muhammad Adeel Ahmed Pasha, Assistant Professor at LUMS for a two-month stay in July-August.

PhD Student Nabil Ghanmy (University of Sfax, Tunisia) for one month in November-December.

PhD Student Tomofumi Yuki (Colorado State University, USA) for two months in November and December.

Prof. Sanjay Rajopadhye (Colorado State University, USA) for one week in December.

7.4.2. Internships

Simara Pérez Zurita (from Oct 2012 until Aug 2013)

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

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

CELTIQUE Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. *The PiCoq ANR project*

Participant: Alan Schmitt.

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 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.

7.1.2. *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 founded 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.

7.1.3. *ANR DECERT project*

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

The DECERT project (2009–2012) is funded by the call Domaines Emergents 2008, a program of the Agence Nationale de la Recherche.

The objective of the DECERT project has been to design an architecture for cooperating decision procedures, with a particular emphasis on fragments of arithmetic, including bounded and unbounded arithmetic over the integers and the reals, and on their combination with other theories for data structures such as lists, arrays or sets. To ensure trust in the architecture, the decision procedures will either be proved correct inside a proof assistant or produce proof witnesses allowing external checkers to verify the validity of their answers.

This is a joint project with Systerel, CEA List and Inria teams Mosel, Cassis, Marelle, Proval and Celtique (coordinator).

7.1.4. Labex COMIN Labs Seccloud project

Participants: Frédéric Besson, 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 objective 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.

7.2. European Initiatives

7.2.1. Collaborations with Major European Organizations

Imperial College (UK)

The JScert project (<http://jscert.org>) aims to really understand JavaScript by building models of ECMAScript semantics in the Coq proof assistant, and automated logical reasoning tools built on those semantics.

7.3. International Initiatives

7.3.1. Inria International Partners

Delphine Demange and David Pichardie have been working with Gilles Barthe from IMDEA Software, Madrid, Spain about the new verified SSA middle-end.

7.4. International Research Visitors

7.4.1. Visits to International Teams

David Pichardie has spent one year at Purdue University, Indiana, US (from September 2011 to August 2012) working with Jan Vitek and Suresh Jagannathan. This was a one year Inria sabbatical leave. The collaboration deals with the formal verification of a Java compiler, taking into account concurrency. As a first result, a paper will appear at POPL 2013 where we provide a new intermediate memory model for the Java language.

ESPRESSO Project-Team

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 - Feb. 2014

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 and CESAR 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.

The current activities in the project consist in gathering and writing detailed documentation about the project context, requirements and constraints. We are now familiar with the technologies involved in the project and started refining high-level requirements so as to express technical objectives and solutions. The P formalism is still in the process of being defined and some aspects of the language are unknown (namely the software architecture formalism). For the subset of P that is sufficiently known and stable, we are investigating the semantical mapping between P and Signal with respect to controller synthesis.

7.1.3. CORAC

Program: CORAC

Project acronym: CORAIL

Project title: Composants pour l'Avionique Modulaire Étendue

Duration: Sep. 2011 - Dec. 2016

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. European Initiatives

7.2.1. Collaborations in European Programs, except FP7

Program: ARTEMIS

Project acronym: CESAR

Project title: Cost-efficient methods and processes for safety relevant embedded systems

Duration: March 2009 - June 2012

Coordinator: AVL List GmbH

Other partners: 59 project partners (main partners for us: AIRBUS, IRIT (CNRS)...)

URL: <http://www.cesarproject.eu/>

Abstract:

In the context of CESAR, we have participated to the sub-project 3 demonstrator in order to demonstrate the usability of Polychrony as a co-simulation tool within the reference technology platform of the project, to which its open-source release has been integrated. The case-study, implemented in collaboration with Airbus and IRIT, consists of co-modeling the doors management system of an Airbus A350 by merging its architecture description, specified with AADL, with its behavioral description, specified with Simulink.

In this case-study, we demonstrate that the Polychrony toolset can effectively serve as a modeling infrastructure to compositionally assemble, compile and verify heterogeneous specifications (AADL and Simulink). Our case study covers code generation for real-time simulation and test as well as

formal verification both at system-level and in a GALS framework. Based on that case study, we are developing further modular code-generation services, real-time simulation, test and performance evaluation, formal verification as well as the validation of the generated concurrent and distributed code.

Program: ITEA2

Project acronym: OPEES

Project title: Open Platform for the Engineering of Embedded Systems

Duration: Feb. 2009 - Dec. 2012

Coordinator: Obeo

Other partners: 30 partners (main partners for us: Airbus, CS Communication & Systèmes, INDRA (Spain), INPT/IRIT...)

URL: <http://www.opees.org/>

Abstract: The ITEA2 project OPEES is the continuation of the ANR project OPENEMBEDD to provide an open-source platform for embedded software design. Its outcome will outlive the duration of the project as it has given rise to an Industrial Working Group of the Eclipse consortium, Polarsys, whose goal is to host and maintain the proposed open-source platform and guarantee its long-term availability.

The mission of OPEES is to build a community able to ensure durability of innovative engineering technologies in the domain of critical software-intensive embedded systems. Its main objectives are to secure the industrial strategy, improve their competitiveness and develop the European software industry.

Our goal in the OPEES project was to deliver the Polychrony toolset on the Polarsys platform as an infrastructure for the co-simulation and co-verification of embedded architectures. To this end, Polychrony has been under a quality assessment process performed in collaboration with CS.

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. POLYCORE

Title: Polychronous models

Inria principal investigator: Jean-Pierre Talpin

International Partner (Institution - Laboratory - Researcher):

Virginia Tech (United States) - Fermat Laboratory - Sandeep Shukla

Duration: 2011 - 2013

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

Inria Associate Project POLYCORE starts from an observation that can be shared with anyone how experienced with multi-threaded programming, to acknowledge 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 however necessary for safe execution of such code on embedded architectures. It is therefore desirable to synthesize multi-threaded code from formal specifications using a provably ‘correct-by-construction’ approach.

While time-triggered programming model simplifies code generation, our shared intuition is that multi-rate event driven execution models are much more efficiently adapted to tackle embedded software design challenges posed by forthcoming heterogeneous multi-core embedded architectures. To this aim, we 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 data-flow paradigm: Polychrony. It aims at combining the capabilities of Esterel/Quartz (ESG/TUKL) for correctly programming synchronous modules, with the capabilities of Polychrony (Inria), to give high-level abstractions of complex multi-clocked networks and yet provide powerful communication and scheduling code synthesis, all combined in an application-specific modeling and programming environment, design in collaboration with Virginia Tech and the AFRL [12], [11]. This year, we laid novel semantical foundations to designing our envisioned environment by defining a constructive semantic encompassing the polychronous data-flow model of Signal and the reactive synchronous imperative model of Quartz, and allowing to formulate the very first executable, small-step, structured operational semantics of Signal [17].

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Pr. John Koo (SIAT, Shenzhen) visited ESPRESSO in summer 2012 with the support of the University of Rennes 1. During his stay, we elaborated a collaboration plan and project proposal on integrated discrete/continuous/hardware simulation with LIAMA.

In the context of the associate project Polycore, Jens Brandt (TU Kaiserslautern) visited ESPRESSO in June to share code generation techniques in Quartz and Signal. Loïc Besnard visited Virginia Tech in June to present the open-source release of Polychrony and explore possible uses of Polychrony in the MRCDIF environment developed at the FLVT. Jean-Pierre Talpin visited Virginia Tech in May and October to prepare our work on Quartz and Signal and jointly draft a project proposal for the USAFRL.

7.4.2. Visits to International Teams

Jean-Pierre Talpin received a grant as invited scientist by the Chinese Academy of Science to visit the Shenzhen Institute for Advanced Technology in December 2012 and further ongoing collaborations with Pr. Koo and LIAMA.

S4 Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. *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 [10] 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 6.2
- 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 [15], [26]. See 6.3 for further details.

7.2. European Initiatives

7.2.1. *Collaborations in European Programs, except FP7*

Program: ITEA 2

Project acronym: MODRIO

Project title: Model driven Physical Systems Operation

Duration: Sep 2012 - Aug 2015

Coordinator: EDF (France)

Other partners: ABB (Sweden and Germany), AIT (Austria), Ampère - INSA Lyon and CNRS (France), Bielefeld university (Germany), Dassault Aviation (France), DLR (Germany), DPS (France), Dassault Systèmes (France), EADS (France), Enicon (Austria), Equa Simulation (Sweden), IFPEN (France), Ilmenau university (Germany), ITI (Germany), KUL (Belgium), Knorr-Bremse (Germany), Linköping university (Sweden), LMS Imagine (France and Belgium), MathCore Engineering (Sweden), Modelon AB (Sweden), Pöyry Finland Oy (Finland), QTronic (Germany), Scania (Sweden), Semantum Oy (Finland), Sherpa Engineering (France), Siemens AG (Germany), Siemens Industrial Turbomachinery AB (Sweden), Simpack AG (Germany), Supméca (France), Triphase (Belgium), University of Calabria (Italy), Vattenfall (Sweden), VTT (Finland), Wapice Ltd. (Finland).

Abstract: MODRIO seeks solutions to support adoption of model-based systems engineering in the design of mechatronic systems. The project covers all phases of the development cycle - from early concept design, over detailed system design, to verification and validation - and operational use including diagnostics during the entire system's life cycle.

7.3. International Initiatives

7.3.1. *Participation In International Programs*

Eric Badouel is contributing to the ALOCO research project of the LIRIMA, on component-based software architectures (<http://www.lirima.uninet.cm/index.php/component/content/article?id=2>).

7.4. International Research Visitors

7.4.1. Internships

Hela GOMRI (from Mar 2012 until Sep 2012)

Subject: Systèmes collaboratifs à l'aide de documents actifs.

Institution: Ecole Nationale d'Ingénieurs de Tunis (Tunisia)

TASC Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

1. The goal of **Ligéro** is to create an internationally visible regional research group putting together the key actors in the domain of Operations Research in the Pays de la Loire region.
2. A regional grant from the **Région Pays de la Loire** for inviting in Nantes a senior researcher was obtained end of 2012 (6 months in 2013 and 2014 for **Helmut Simonis**) on *learning generic constraint models*.

8.2. National Initiatives

1. Cooperation with **J.-C. Régin** from **Univ. Nice** on efficient graph filtering algorithms.
2. Cooperation with **A. Miné** from **ENS Paris** on abstract domains by **M. Pelleau** and **C. Truchet**.

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations

- SICS**, Computer Systems Laboratory (Sweden)
Global Constraint Catalog, scalable global constraints.
- 4C**, (Ireland)
Learning constraint models.
- Uppsala University**, (Sweden)
Automata and constraints.

8.4. International Initiatives

8.4.1. Inria 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**.
- **École Polytechnique de Montreal**, Canada: Work on graph constraints with **Louis Martin Rousseau**.
- **JFLI**, Japan: Work with **Philippe Codognet**.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

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

8.5.1.1. Internships

- Naina Razakarison (internship of **ENS Cachan** in summer 2012 on learning generic models).
- Mohamed Kebe (internship of **Clermont University** in summer 2012 on reformulations of the *cumulative* constraint).

8.5.2. 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**.

VERTECS Project-Team

7. Partnerships and Cooperations

7.1. National initiatives

7.1.1. ANR VACSIM: Validation of critical control-command systems by coupling simulation and formal analysis

Participants: Nathalie Bertrand, Thierry Jéron, Hervé Marchand.

The Vacsim project (2011-2014) is a 3-year project with EDF R&D, Dassault Systèmes, LURPA Cachan, I3S Nice and Labri Bordeaux. The project aims at developing both methodological and formal contributions for the simulation and validation of control-command systems. The role of the Vertecs team will be to contribute to the advance of validation techniques for timed systems, including quantitative analysis and its application to testing, monitoring of timed systems, and verification of communicating timed automata. The VACSIM project funds the PhD thesis of Srinivas Pinisetty.

7.1.2. ANR Ctrl-Green (Autonomic management of green data centers)

Participant: Hervé Marchand.

The project Ctrl-Green (2011-2014) is a 3-year project with UJF/LIG, INPT/IRIT, Inria, 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. The role of the Vertecs team will be to contribute to the development of new controller synthesis methodology for symbolic synchronous systems handling variables and to its application to the autonomic management of data centers.

7.2. European Initiatives

7.2.1. Artist design network of excellence

Participants: Nathalie Bertrand, Thierry Jéron, Hervé Marchand.

Program: FP7

Project acronym: Artist Design

Project title: Artist - European Network of Excellence on Embedded System Design

Duration: 01/08 - 03/12

Coordinator: VERIMAG

Abstract: The central objective for **ArtistDesign** is to build on existing structures and links forged in Artist2, to become a virtual Center of Excellence in Embedded Systems Design. This will be mainly achieved through tight integration between the central players of the European research community. Also, the consortium is smaller, and integrates several new partners. These teams have already established a long-term vision for embedded systems in Europe, which advances the emergence of Embedded Systems as a mature discipline.

The research effort aims at integrating topics, teams, and competencies, grouped into 4 Thematic Clusters: “Modelling and Validation”, “Software Synthesis, Code Generation, and Timing Analysis”, “Operating Systems and Networks”, “Platforms and MPSoC”. “Transversal Integration” covering both industrial applications and design issues aims for integration between clusters.

The Vertecs EPI is a partner of the “Validation” activity of the “Modeling and Validation” cluster. This year, the Vertecs EPI has contributed to quantitative verification of timed automata [20], test generation from nondeterministic timed automata [7], and control synthesis using abstract interpretation for infinite state systems [12].

7.2.2. Major European Organizations with which the Team has followed Collaborations

Université Libre Bruxelles (Belgium), Prof. Thierry Massart, Testing and control of symbolic transitions systems.

University of Kaiserslautern (Germany), Roland Meyer, Petri nets.

University of Dresden (Germany), Prof. Christel Baier, Probabilistic automata over infinite words.

University of Mons (Belgium), Prof. Thomas Brihaye, Stochastic timed automata.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

Laurie Ricker, associate professor at the Mathematics & Computer Science department of Mount Allison University (Canada) has visited VerTECS for 6 months, from January 2012 to June 2012. We collaborate on control of discrete event systems for distributed and decentralized systems.

7.3.2. Visits to International Teams

Nathalie Bertrand spent 9 months at University of Liverpool, from November 1st 2011 to July 31st 2012. Her visit was supported by the Leverhulme Trust and the Sabbatical program of Inria, which also permitted Paulin Fournier to spend 5 months at University of Liverpool for his Master thesis.

ASPI Project-Team

6. Partnerships and Cooperations

6.1. National initiatives

6.1.1. Ensemble methods for prediction and data assimilation (PREVASSEMBLE) — ANR Conception et Simulation

Participants: François Le Gland, Valérie Monbet.

See 5.14 .

Inria contract ALLOC 3767 — January 2009 to December 2012.

This ANR project is coordinated by École Normale Supérieure, Paris. The other partner is Météo-France. This is a collaboration with Étienne Mémin and Anne Cuzol (Inria Rennes Bretagne Atlantique, project-team FLUMINANCE).

The contribution of ASPI to this project is to continue the comparison of sequential data assimilation methods initiated in [73], [62], such as the ensemble Kalman filter (EnKF) and the weighted ensemble Kalman filter (WEnKF), with particle filters. This comparison has been made on the basis of asymptotic variances, as the ensemble or sample size goes to infinity, and also on the impact of dimension on small sample behavior.

The consortium has organized the international conference on *Ensemble Methods in Geophysical Sciences*, held in Toulouse in November 2012.

I4S Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. *Pôle de Compétitivité ASTECH MODIPRO*

Participants: Laurent Mevel, Meriem Zghal.

Contract Inria 4162

I4S is implied in a national project for aircraft SHM starting Fall 2009. This project will improve on monitoring procedures developed in previous projects to provide some algorithms for use in Dassault Aviation aircraft monitoring procedures. I4S works together with Qinghua Zhang of Inria Rocquencourt, project team SISYPHE, on this topic. The project ended in October 2012.

8.1.2. *Collaboration with IFSTTAR*

Participant: Laurent Mevel.

I4S is related to the project FUI SIPRIS (Systèmes d'Instrumentation pour la prévention des risques), lead by Advitam. Work has just started with IFSTTAR.

8.1.3. *Collaboration with ALEA, EPI Team at Inria Bordeaux Center*

Participants: Laurent Mevel, Meriem Zghal.

I4S has a 2 year collaboration with EPI ALEA on using particular filtering in vibration analysis. The output has been submitted for publication.

8.1.4. *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. See also [25].

8.2. European Initiatives

8.2.1. *FP7 Projects*

8.2.1.1. *FP7 ISMS*

Type: PEOPLE

Instrument: Industry-Academia Partnerships and Pathway (IAPP)

Duration: September 2010 - August 2013

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 Döhler 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 Döhler has been spending 5 months in 2010-2011 in Danemark. Laurent Mevel spent 2 months in 2012 in Danemark. The mid term project has been well reviewed by the EC.

8.2.1.2. FP7-NMP CP-IP 213968-2 IRIS

Type: Cooperation

Instrument: Collaborative project -Large Scale Integrating project

Duration: October 2008 - March 2012

Coordinator: VCE, Austria (Denmark)

Others partners: 40 partners

IIRIS (*Integrated European Industrial Risk Reduction System*), which holds its kick off meeting in October 2008. This project has been elaborated within the framework of the SAMCO association. I4S is involved in the online monitoring sub-project.

I4S is involved in the core consortium of this FP7-NMP Large Scale Integrated Project.

Inria is involved in Group 3 about Structural Health Monitoring. I4S works with Sheffield University and BAM (Germany) for development of tools for structural damage detection for bridges and wind farms. Laurent Mevel is also member of the core IRIS Vision group, and is responsible of the scientific coherency of the project.

The project ended in Spring 2012.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. SIMS, Canada

Participants: Michael Döhler, 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. A contract has been signed, where 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.

8.3.1.2. Collaboration on damage localization and monitoring with Boston University

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

8.3.2. Participation In International Programs

8.3.2.1. Northeastern University

Participants: Laurent Mevel, Luciano Marin.

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 new PhD student, Luciano Marin, and is involving Professor Bernal from University of Boston, USA.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Michael Döhler of Northeastern University has visited twice in June and September 2012 for a total of 4 weeks.

IPSO Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR Programme blanc (BLAN) MEGAS: 2009-2012

Participants: François Castella, Philippe Chartier, Arnaud Debussche, Erwan Faou.

Geometric methods and sampling: application to molecular simulation. The project was financed for 3 years, coordinated by Tony Lelièvre and has gathered the following teams and persons:

- Team of Eric Cancès at CERMICS
- Team IPSO
- Mathias Rousset from Inria Lille
- Christophe Chipot, from the CNRS in Nancy.

P. Chartier was the coordinator for IPSO.

6.1.2. ANR Programme blanc GYPSI: 2010-2014

Participant: Nicolas Crouseilles.

Leader: Ph. Gendrih.

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

6.1.3. ANR Programme blanc E2T2: 2010-2014

Participant: Nicolas Crouseilles.

Leader: P. Beyer

6.1.4. ANR Programme blanc STOSYMAP

Participant: Arnaud Debussche.

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

6.1.5. Inria Large scale initiative FUSION

Participant: Nicolas Crouseilles.

Leader: E. Sonnendrücker. The full description is available at http://www-math.u-strasbg.fr/ae_fusion

6.2. European Initiatives

6.2.1. FP7 Projects

6.2.1.1. <http://www.irisa.fr/ipso/perso/faou/geopardi.html> 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.

6.3. International Initiatives

6.3.1. Participation In International Programs

6.3.1.1. ANR Programme blanc international (BLAN) LODIQUAS 2012-2015

Participants: François Castella, Philippe Chartier, Florian Méhats, Mohammed Lemou.

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

The project, entitled "LODIQUAS" (for: Low DIMensional QUANtum Systems), received 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), Joerg Schmiedmayer (Vienna), Hans-Peter Stimming (Vienna).

Francois Castella (IPSO), Florian Mehats (IPSO), Francis Nier (Rennes), Raymond El Hajj (Rennes), Mohammed Lemou (IPSO), Claudia Negulsecu (Toulouse), Fanny Delebecque (Toulouse), Stephane Descombes (Nice), Philippe Chartier (IPSO), Christophe Besse (Lille),

The expected scientific and technological progress brought by the present project are as follows. "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.

6.4. International Research Visitors

6.4.1. Visits of International Scientists

- Mechthild Thalhammer, University of Innsbruck, one week
- Yong Zhang, University of Vienna, three weeks

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 3 months).

DYLISS Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. *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 (Ircyn). This is acted through the Biotempo and Idealg ANR projects and co-development of common software toolboxes within the Renabi-GO platform process. Two Ph-D thesis are also co-supervised within these collaborations.

7.1.2. *Partnership in Marine Biology*

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

A strong application domain of the Dyliss project is marine Biology. This application domain is co-developped 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 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 modelling of the initiation of sea-urchin translation (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 P-F. Pluchon) and the dentification of key actors implied in competition for light in the ocean (PELICAN ANR project).

7.1.3. *Partnership with Inra and Health*

Participants: Jacques Nicolas, Catherine Belleannée, François Coste, Michel Le Borgne, Anne Siegel, Oumarou Abdou-Arbi, Geoffroy Andrieux, Pierre Blavy, Valentin Wucher.

We have a strong and long term collaboration with biologists of INRA in Rennes : IGEEP and SENAH units. This partnership is acted by the co-supervision of one post-doctorant and two PhD students. It 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 a co-supervised Ph-D thesis. This partnership is reinforced with the ANR contract Biotempo and has been also supported in the framework of the previous CPER by a project, BasicLab, on a lab on chip for cell assays.

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 softwares 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) 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, François Coste, 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 sector (CNRS, IFREMER, UEB, UBO, UBS, ENSCR, University of Nantes, INRA, AgroCampus), the industrial sector (C-WEED, Bezhin Rosko, Aleor, France Haliotis, DuPont) as well as a technical centre 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.

7.2.2. Methodology: ANR Biotempo

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

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 β signaling and initiation of sea-urchin translation. It is funded by ANR Blanc (SIMI2) and coordinated by A. Siegel from 2011 to 2014. [\[details\]](#)

7.2.3. Proof-of-concept on dedicated applications

7.2.3.1. ANR Fatinteger

Participants: Anne Siegel, Jacques Nicolas, Catherine Belleannée, Pierre Blavy.

This project (ANR Blanc SVE7 "biodiversité, évolution, écologie et agronomie" from 2012 to 2015) is led by INRA UMR1348 PEGASE (F. Gondret). It is interested by 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 2012. 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 Miradapt

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. [\[details\]](#)

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) [\[details\]](#).

7.2.4.2. Aquasyst

Participants: Damien Eveillard, Anne Siegel.

PEPS contract 2011-2012 whose goal is to combine Environmental genomics and Systems biology for the understanding of aquifere denitrification.

7.3. European Initiatives

7.3.1. Collaborations with Major European Organizations

Partner: EBI (Great-Britain)

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

Partner: Potsdam university (Germany)

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: SIEGEL Anne

International Partner (Institution - Laboratory - Researcher):

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

Duration: 2011 - 2013

See also: <http://www.irisa.fr/symbiose/people/asiegel/EA/>

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-stay visitings in France to initiate long-term research lines, in complement to short visit funded by and inria-conycit program.

7.4.2. Participation In International Programs

7.4.2.1. Argentina - MinCYT-Inria 2011-12

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 2011-12

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

7.4.2.2. International joint supervision of PhD agreement

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

Inria principal investigator: Anne Siegel

International Partners (Institution - Laboratory - Researcher):

University of Chile (Chile)

Duration: Jul 2011 - Jul 2014

Title: Analyse automatisée et générique de réseaux métaboliques en nutrition

Inria principal investigator: Anne Siegel

International Partner (Institution - Laboratory - Researcher):

University of Ouagadougou (Burkina Faso)

Duration: October 2010 - September 2013

7.4.2.3. Germany. Egide Procope Program 2011-12

Program: PHC

Title: Reasoning in systems biology with answer set programming.

Inria principal investigator: Jacques Nicolas

International Partner :

University of Potsdam (Germany)

Institut für Informatik Wissensverarbeitung und Informationssysteme

T. Schaub

Duration: Jan 2011 - Dec 2012

The cooperation addresses various aspects of the development of the Answer Set Programming approach in bioinformatics. Based on formal methods for the Analysis of big metabolic networks we developed a new approach with Answer Set Programming. This approach can be used to check whether a network contains the reaction pathways that explain the bio-synthetic behavior of the organism. Further we developed an approach for the learning of logical models of protein signaling networks.

7.4.2.4. Amadeus (Austria)

Program: PHC

Title: From fractals to numeration

Inria principal investigator: Anne SIEGEL

International Partner (Institution - Laboratory - Researcher):

University of Leoben (Austria)

Duration: Jan 2011 - Dec 2012

7.5. International Research Visitors

7.5.1. Visits of International Scientists

- **Germany.** Department of Computer Science, Potsdam. 5 days [T. Schaub, M. Gebser, M. Ostrowski]
- **Chile.** Centro de Modelamiento Matemático, Santiago. 10 days [A. Maass]

7.5.1.1. Internships

- Internship April to July, 2012. Co-supervised by Anne Siegel and Sylvain Prigent. Student : Floriane Ethys de Corny. Subject: Improvement of metabolic networks. Application to *Ectocarpus siliculosus*.

7.5.2. Visits to International Teams

- **Austria.** Department of Mathematics, Leoben & Vienna. *Dynamical systems*. 5 days [A. Siegel]
- **Burkina-Faso.** Department of Computer Science, Oagadougou. *Multi-objective methods for the static analysis of metabolic network*. 2 months [O. Abdou-Arbi]
- **Chile.** Centro de Modelamiento Matemático, Santiago. *Metabolic modeling of bacteria*. 14 days [D. Eveillard]
- **Chile.** Centro de Modelamiento Matemático, Santiago. *Data integration*. 7 days [A. Siegel]
- **Chile.** Centro de Modelamiento Matemático, Santiago. *Applications of ASP*. 21 days [S. Thiele]
- **Chile.** Centro de Modelamiento Matemático, Santiago. *Applications of ASP*. 10 days [S. Videla]
- **Germany.** Department of Computer Science, Potsdam. *Constraint-based approaches*. 5 days [J. Nicolas]
- **Germany.** Department of Computer Science, Potsdam. *Application of ASP to biology*. 5 days [A. Siegel]
- **Germany.** Department of Computer Science, Potsdam. *Reconstruction of metabolic networks*. 10 days [S. Thiele]
- **Germany.** Department of Computer Science, Potsdam. *Learning logical rules for protein signaling networks*. 2 months [S. Videla]
- **Niger.** University of Maradi. *Multi-objective methods for the static analysis of metabolic network*. 1 month [O. Abdou-Arbi]
- **UK** EMBL-European Bioinformatics Institute. *Learning logical rules for protein signaling networks*. 3 days [S. Videla]

FLUMINANCE Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. *Britanny concil ARED IMAGEO:*

Participants: Cédric Herzet, Etienne Mémin, Véronique Souchaud.

duration 36 months. This project of the Brittany 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.

7.2. National Initiatives

7.2.1. *ANR-COSINUS PREVASSEMBLE: Ensemble methods for assimilation of observations and for prevision in Meteorology and Oceanography*

Participants: Sébastien Béyou, 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 prediction. 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).

7.2.2. *ANR SYSCOMM MSDAG: MultiScale Data Assimilation in Geophysics*

Participants: Pierre Dérian, 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 lead 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 CEREAL/ CLIME Inria group (leader), the LSCE/CEA, the Inria groups MOISE and FLUMINANCE.

7.2.3. *ANR SYSCOMM GeoFluids:*

Participants: Patrick Héas, Dominique Heitz, Souleymane Kadri Harouna, Etienne Mémin, Véronique Souchaud.

duration 48 months.

The project Geo-FLUIDS focuses on the specification of tools to analyse 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, IPSO, 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.

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. HURACAN

Title: Analysis and control of fluid flows from image sequences

Inria principal investigator: Etienne Memin

International Partners (Institution - Laboratory - Researcher):

IRSTEA (France)

University of Buenos Aires (Argentina)

Duration: 2010 - 2012

See also: <http://huracan.inria.fr>

The HURACAN associated team is centered on the analysis and the control of fluid flows from image sequences. The research objectives of this team are organized into two distinct work axes. The first one aims at defining and studying visual servoing techniques for fluid flows control. In addition to the definition of efficient visual servoing schemes this axis of work gathers research issues related to fluid flows velocity measurement from images and to flows excitation through plasma actuators. The second research axis focuses on the coupling between large scales representations of geo-physical flows and image data. More precisely, it aims at studying means to define directly from the image sequences the small scales terms of the dynamics. This research axis includes the study of coupling models and data defined at different scales, problems of multiscale velocities estimation respecting turbulence phenomenological laws and issues of experimental validation.

7.3.2. Participation In International Programs

STIC AmSud project "Physics-based modeling of voice production" leaded by D. Sciamarella CNRS/LFD-FIUBA.

This project is an interdisciplinary project with researchers spanning from aeroacoustics to physiology, and from computational physics to phonetics. It aims at studying the mechanisms of human voice production system for applications ranging from man-machine communication to medical diagnosis.

GENSCALE Team

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 aims at developing new methods to detect complex variation (structural variations) in non-assembled NGS data. It is funded from Sept. 2012 until August 2013 and coordinated by C. Lemaitre.

8.1.2. Partnership with INRA

Participants: Thomas Derrien, Anaïs Gouin, Fabrice Legeai, François Moreews, Raluca Uricaru.

We have a strong and long term collaboration with biologists of INRA in Rennes : IGEPP and SENAH units. This partnership concerns both service and research activities and is acted by the hosting of two engineers (F. Legeai, F. Moreews) and by the co-supervision of two post-doctorants and one non permanent engineer. 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. BIOWIC

Participants: Rumen Andonov, Dominique Lavenier, François Moreews.

The BioWIC project aims to speed up both the design and the execution of bioinformatics workflows. It is funded by ANR call ARPEGE and coordinated by D. Lavenier from Jan. 2009 to June 2012. <http://biowic.inria.fr/>

8.2.1.2. MAPPI

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

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

8.2.1.3. 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.

8.2.1.4. SPECIAPHID

Participants: Thomas Derrien, 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.

8.2.1.5. 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 post-genomic and regulatory data. It is funded by ANR call BLANC and coordinated by E. d'Alençon (Inra, Montpellier) from October 2012 to Dec. 2015.

8.2.1.6. 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.

8.2.1.7. LEPIDOLF

Participants: Dominique Lavenier, Fabrice Legeai.

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) from 2009 to 2012. As part of this project, a post-doctoral student, Aurore Gallot, visited Genscale for 5 months.

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, 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 2012.

8.2.2.3. BioManyCores

Participants: Guillaume Chapuis, Charles Deltel, Dominique Lavenier.

The BioManyCores project aims to develop a library of bioinformatics softwares implemented on manycore structures such as GPU. It is funded by Inria ADT call and supervised by J.S. Varré in Sequoia Team in Lille. <http://www.biomanycores.org/>

8.2.2.4. ParaQtlMap

Participants: Guillaume Chapuis, Charles Deltel, Dominique Lavenier.

The ParaQtlMap project is a joint initiative from Genscale team and Genetique Animale. to design high performance software for detecting quantitative trait locus. It is funded by Inria/INRA call and coordinated by D. Lavenier (Genscale) and P. Leroy (GA INRA) from oct. 2010 to sept. 2012. https://qgp.jouy.inra.fr/index.php?option=com_content&task=view&id=17&Itemid=28

8.2.2.5. *Barcoding de nouvelle génération*

Participants: Dominique Lavenier, Claire Lemaitre, Pierre Peterlongo.

This project is a joint initiative between Genscale and LECA (Laboratoire d'Ecologie Alpine in Grenoble). It aims at developing 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 december. 2013.

8.2.2.6. *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.

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. *Participation In International Programs*

8.4.1.1. *CONICYT (Chile)*

Program: Coopération bilatérale CNRS

Title: Wine fermentation analysis by biclustering

Inria principal investigator: Antonio MUCHERINO

International Partner (Institution - Laboratory - Researcher):

Technical University Federico Santa Maria (Chile)

Duration: Jan 2012 - Dec 2012

This project aims at using data mining techniques for predicting problematic wine fermentations from the first stages of the fermentation process.

8.4.2. Collaborations

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

- Carlile Lavor, from IMECC-UNICAMP, Campinas-SP, Brazil, visited Genscale 3 times (2 times, for 1 week, funded by his own projects and 1 time, for 1 month, funded by "mois ISTIC").
- Alejandra Urtubia, from Universidad Tecnica Federico Santa Maria, Valparaiso, Chile, visited genscale for 2 weeks. This visit was funded by CNRS-CONICYT project on wine fermentation (A. Mucherino).
- Hristo Djidjev from Los Alamos, USA, visited Genscale for a month in the framework of University of Rennes 1 visiting positions "professeur invité".
- Van-Hoa Nguyen from University of Angiang, Viet Nam, visited GenScale for 3 months (nov. 2012 - jan. 2013). The visit was funded by the French Mastodons program from CNRS to research focusing on bioinformatics big data problem.
- Rafael Santos, from UNICAM, Bresil, visited GensCale for 3 months (oct. 2012 - dec. 2012). The visit was funded by CNPq (collaboration with A. Mucherino on protein structure).
- Virginia Silva da Costa, from the Federal University of Rio, Bresil, visited Genscale for 4 months (mar. 2012 - june 2012), funded by CAPES.
- Mariade Cola, from the University of Rome, Italia, visited Genscale for 3 months (apr. 2012 - june 2012), funded by IASI-CNR.
- Sharat Bogaraju, from IIT Delhi, India, visited GenScale for 6 months (dec. 2011 - may 2012). The visit was funded by Rennes Metropole (International exchange of PhD Students). Collaboration with D. Lavenier on parallel bioinformatics algorithms .

8.5.2. Visits to International Teams

- Antonio Mucherino visited IMECC-UNICAMP, Campinas-SP, Brazil, for 2 months, under the program "chaires française à São Paulo"
- Claire Lemaitre and Pierre Peterlongo visited for 1 week the "Laboratory of Bioinformatics and Mathematics of the Genome" hosted at CMM at University of Chile. The visit was funded by CIRIC-omics research line of the Inria center in Chile.
- Nicolas Maillet (PhD) visited during three months the LNCC (Laboratório Nacional de Computação Científica) in Petropolis (state of Rio de Janeiro, Brazil) from March to June 2012.
- Mathilde Le Boudic-Jamin (PhD) visited the CWI in Amsterdam, Neetherlands (June 2012, one month) and collaborated with Gunnar KLAU and Inken WOHLERS on the family identification problem.

SAGE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR-MN: H2MNO4 project

Participants: Thomas Dufaud, Jocelyne Erhel, Grégoire Lecourt, Aurélien Le Gentil, Lionel Lenôtre, Géraldine Pichot.

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 Cuyolla.

Partners: Geosciences Rennes, University of Poitiers, University of Lyon 1, Andra, Itasca.

Web page: <http://www.irisa.fr/sage/>

Abstract: The project H2MNO4 will develop 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 6.4.1 , 6.4.3 , 5.1).

8.1.2. Inria Large Wingspan initiative: HEMERA project

Participants: Jocelyne Erhel, Géraldine Pichot.

Title: Hemera

Duration: from September 2010.

Coordination: C. Perez, GRAAL team.

Partners: 22 Inria teams.

Webpage: <http://www.grid5000.fr/mediawiki/index.php/Hemera>

Abstract: Hemera is an Inria Large Wingspan project, 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 6.4.1 , 6.5).

8.1.3. Inria Large Wingspan initiative: C2S@EXA project

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

Title: C2S@EXA

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 large-scale initiative 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 6.1.2 , 6.1.3 , 6.1.5 , 6.4.5). The team participated in the first workshop France-Brazil on HPC (Nice, July 2012).

8.1.4. Inria Technological development actions: H2OGilde project

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

Title: H2OGilde

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 H2OGilde aims at developing an interface for the platform H2OLab (see 5.1) and at designing software libraries with a large academic diffusion (see 6.4.1 ,6.5 , 8.1.1).

8.1.5. 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 CO₂. 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 6.5 , 5.1).

8.1.6. GENCI: project on advanced linear solvers

Participants: Édouard Canot, Jocelyne Erhel, Grégoire Lecourt, Aurélien Le Gentil, 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, AGMRES, GRT3D and MUESLI (see 5.1 , 5.9 , 5.6 , 5.11). We obtained and used computing time on machines located at Idris supercomputing center (see 6.1.2 , 6.1.3 , 6.4.1 , 6.5).

8.1.7. GNR MOMAS: project on reactive transport

Participants: Jocelyne Erhel, Souhila Sabit.

Webpage: <http://momas.univ-lyon1.fr/>

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.

8.2. European Initiatives

8.2.1. 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 , 6.4.1 , 6.5).

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 editing a book, in writing a book, and in common research on low rank approximations of matrix functions (see 6.2.1).

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

8.3. International Initiatives

8.3.1. Inria International Partners

University of Kent (USA)

Krylov methods (see 6.1.1)

University of Purdue (USA)

High Performance Scientific Computing (see 6.2.1)

8.3.2. Cedre (Lebanon): MODNUM project

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.

8.3.3. 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.

8.3.4. Inria Euro Med 3+3: HYDRINV project

Participants: Amine Abdelmoula, 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 Ameer, 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 Ameer

Duration: Jan 2012 - Dec 2015

Abstract: 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.

8.3.5. LIRIMA laboratory: MOMAPLI 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 Noutchequeme

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 6.2.2).

8.3.6. LIRIMA laboratory: EPIC team (Tunisia)

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

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.

8.3.7. 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 6.1.2) and on domain decomposition methods (see 6.5.4). The team Sage participated in the workshop organized in June in Rennes (France).

8.3.8. Joint supervision of M. Oumouni's PhD (Morocco)

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 - Aug 2012

Abstract: see 6.4.4 .

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

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 - 2013

Abstract: The objective is to solve data completion problems applied to hydrogeology (see 8.3.4 , 8.3.6).

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

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 8.3.4 , 8.3.6).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Basile Louka, 3 weeks, December 2011-January 2012; see 8.3.5 .
- Norbert NOUTCHEGUEME, 2 weeks, January 2012; see 8.3.5 .
- Stratis Gallopoulos, 1 week in January 2012 and 1 week in December 2012; see 6.2.1 , 8.2.1 .
- Ahmed Sameh, 1 week in January 2012 and 1 week in December 2012; see 6.2.1 , 8.3.1 .
- Emmanuel Kamgnia, 2.5 months, March-April 2012 and December; see 8.3.5 , 6.2.2 .
- Dani Mezher, 1 week, March 2012.
- Nabil Nassif, 1.5 month, June-July 2012; see 6.2.3 .
- Noha Makhoul, 1 week, July 2012; see 6.2.3 .
- Myriam El Fergougui, 1 month, March 2012.

8.4.2. Internships

- Salwa Mansour, 1.5 month, June-August 2012; see 8.3.2 , 6.3.1 .
- Mestapha Oumouni, 1.5 month, May-June 2012; see 8.3.8 , 6.4.4 .

8.4.3. Visits to International Teams

- B. Philippe, 2 weeks, February 2012, University of Yaoundé I, Cameroon; see 8.3.5 , 6.2.2 .
- B. Philippe, 2 weeks, May 2012, Purdue University, USA; see 8.3.1 , 6.2.1 .
- B. Philippe, 1 week, December 2012, ENIT, Tunisia; see 8.3.6 , 8.3.4 , 8.3.10 .

SERPICO Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. *Computing and storage facilities*

Participants: Tristan Lecorgne, Charles Kervrann.

The aim is to design a computing architecture to process bioimaging data sets and to deal with the data flow from the different imaging microscopy platforms. The software packages will manage the needs of end users in Rennes, where interactivity with the imaging devices and information systems are desirable.

Funding: Rennes-Metropole - “Allocation Installation Scientifique”

8.2. National Initiatives

8.2.1. *Quaero project*

Participants: Charles Kervrann, Patrick Bouthemey, Denis Fortun, Solène Ozeré.

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 led 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 (6.3 and 6.4) and Solène Ozeré Internship (6.1)).

Funding: Quaero (no. Inria Alloc 3184), duration: 30 months

Partners: 24 academic and industrial partners led 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 will develop methods and software for the computation of mean velocity as well as other descriptors of swimmers bacteria dynamics inside biofilm image sequences. We will 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. *LI-FLIM project*

Participants: Charles Kervrann, Philippe Roudot.

The goal is to develop lifetime estimation methods of moving vesicles in FLIM microscopy. Grant to support collaboration between SERPICO team and UMR 144 CNRS PICT-IBiSA Institut Curie (P. Roudot's PhD (6.5))

Funding: GdR 2588 "Microscopie Fonctionnelle du Vivant" - Mobility grant

Partner: UMR 144 CNRS PICT IBiSA Institut Curie

8.2.4. DADA project

Participant: Charles Kervrann.

The accurate control of the growing and guidance of neuronal extensions to their target is a very important step for the maturation of the nervous system. The goal of this project (<http://www-sop.inria.fr/members/Xavier.Descombes/DADA/home.html>) is to develop new computational techniques to analyze image sequences of 3D volumes containing a population of growing axons (see Fig. 3).

Funding: Inria ARC (2011-2012)

Partners: Inria Morpheme team and IBDC, laboratory from University of Nice Sophia Antipolis

8.2.5. France-BioImaging project

Participants: Charles Kervrann, Tristan Lecorgne.

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.

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 to 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 to 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 8.2.5.

8.4. International Research Visitors

8.4.1. Visits to International Teams

- Collaboration with University of Saarland (Germany), Prof. J. Weickert, on optical flow computing (D. Fortun's visit in 2012, 3 months, Rennes-Metropole grant).

- 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).

8.4.2. Others

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

VISAGES Project-Team

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 first one 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. The second one led by Erwan Donal, physician at CHU-Rennes, will apply advanced MRI acquisition techniques in cardiac pathology.

8.1.3. *Projet CRITT Santé Bretagne : AfaCorVis3D*

Participants: Elise Banner, 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 Banner, Jean-Christophe Ferré, Christian Barillot, Jean-Yves Gauvrit.

duration: 22 monts from March 2012 (end : December 31, 2013)

The ASLDEM project was partially funded the University of Rennes 1 "Défis Scientifiques Emergents" grant (7000 euros). The ASLDEM project is described in Sect. 6.4.7

8.1.5. *Fondation de l'Avenir 2012 - Depression, suicide and fMRI*

Participants: Elise Banner, 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 2012 - Stroke, rehabilitation and fMRI*

Participants: Elise Banner, 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 rehabilitation 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 2012*

Participants: Elise Bannier, H el ene 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 M enard - Angers (LISA), Dr Langevin - Compi egne (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.

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 Beno t Comb es et al. [48]. The pipeline was first validated on controlled synthetic data. For Parkinson disease, a total of 16 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 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, Pierre Maurel, Jean-Christophe Ferr e, Elise Bannier, Camille Maumet, Isabelle Corouge.

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 contrast 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.

8.3. European Initiatives

8.3.1. 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 Navarra (ES), INSERM U836 Grenoble (FR), University of Rennes I (FR), Centro San Giovanni di Dio - Fatebenefratelli (IT), Fondazione Istituto 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 (Institution - Laboratory - Researcher):

Children's Hospital Boston - Harvard Medical School (United States) - Computational Radiology Laboratory - Simon K. Warfield

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.

ACES Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. *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: November 2013

Bin That Think is a research project funded by the ANR Ecotech program, which aims 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 introduces 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. Bin That Think will use RFID and embedded sensors to enable waste containers as an intelligent waste infrastructure and a network of smart sensors.

ASAP Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. LABEX CominLabs

Participants: Anne-Marie Kermarrec, Davide Frey, Stéphane Weiss.

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.

8.1.2. ANR ARPÈGE project Streams

Participants: Marin Bertier, Michel Raynal, Stéphane Weiss.

The Streams project started in November 2010. Beside the ASAP group, it includes Teams from Inria Nancy and PARIS. Its aim is 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 VERSO project Shaman

Participants: Marin Bertier, Anne-Marie Kermarrec, Michel Raynal.

The Shaman project started in 2009, gathering several members of the team working on distributed systems and distributed algorithms. The aim of this project is to propose new theoretical models for distributed algorithms inspired from real platform characteristics. From these models, we elaborate new algorithms and try to evaluate their theoretical power.

8.1.4. 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) 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 (after 3.5 years of the GOSSPLE ERC SG) 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. AllYours is investigating how to turn such inventions into a successful innovation with high potential targeting both end users and SMEs with an enterprise, semi-centralized, version of the system.

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 will focus 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

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 1 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.

Foundation for Research and Technology Hellas ICS FORTH Greece
Transform

Lancaster University
collaboration on the ERC SG GOSSPLE

Imperial College London
collaboration on the Map-Reduce systems

8.3. International Initiatives

8.3.1. Inria International Partners

University of Calgary

Universidad Nacional Autonoma de Mexico

8.3.2. Participation In International Programs

8.3.2.1. 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

The team welcomed the following research visitors in 2012.

Swan Dubois, Lip 6, 27 January 2012.

Paolo Costa, Imperial College London, from 8 to 10 February 2012 and one week in November.

Rachid Guerraoui, several one week visits in 2012.

Gregor Von Bochmann, University of Ottawa, from 12 to 17 March 2012.

Zekri Lougmiri, Faculté de Sciences d'Oran, 23 April to 4 May 2012.

Zhu Weiping, Hong Kong Polytechnic University, from 15 November 2011 until 14 May 2012.

Anna-Kaisa Pietilainen ; Technicolor Paris, 31 May 2012.

Jean-Pierre Lozzi, Lip 6, 1 June 2012.

Vincent Leroy, Université Joseph Fourier de Grenoble, 29 to 31 October 2012.

Bin Xiao, Hong Kong Polytechnic University, 26 December 2012.

8.4.1. Internships

Mathieu GOESSENS; 6 February 2012 to 6 July 2012. "Peer-to-peer content dissemination". Supervised by Davide Frey and Anne-Marie Kermarrec.

Ilham IKBAL; 1 March 2012 to 15 August 2012. "Integration du routage en oignon (TOR) dans les protocoles epidemiques". Supervised by Davide Frey.

Imane ALIFDAL; 1 March 2012 to 31 August 2012. "Integration du routage en oignon (TOR) dans les protocoles epidemiques". Supervised by Davide Frey.

Benjamin Girault; 19 March to 31 August 2012. "Heterogeneous gossip protocols for news recommendation". Supervised by Anne-Marie Kermarrec.

Asiff Shaik; 3 August 2012 to 2 January 2013. "Understanding offline social networks and its advantages over the online social network ; resolving some challenges in the offline social networks such as privacy, trust, security and scalability.". Supervised by Anne-Marie Kermarrec.

8.4.2. Visits to International Teams

Anne-Marie Kermarrec has been a part-time (50%) visiting professor at EPFL Lausanne since September 2012.

ASCOLA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. CESSA: *Compositional Evolution of Secure Services with Aspects (ANR/ARPEGE)*

Participants: Mario Südholt [coordinator], Diana Allam, Rémi Douence, Hervé Grall, Jean-Claude Royer.

The project CESSA 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.

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

8.1.1.2. Entropy (*ANR/Emergence*)

Participants: Jean-Marc Menaud [coordinator], Thomas Ledoux, Adrien Lèbre.

The Entropy project is an (industrial) ANR/Emergence project running for 18 months. It was accepted in December 2010 for funding amounting to 242 KEUR (ASCOLA only).

The objective of this project is to conduct studies on economic feasibility (market, status, intellectual property, website) for creating a industrial business on the Entropy software.

Some task must complete the Entropy core solution with a graphical unit interface to produce convincing demonstrators and consolidate our actual and future results. At the end of the project, the goal is to create a company whose objective is to sell the service, support and software building blocks developed by this ANR Emergence project.

8.1.1.3. 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. 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) CSLA, a novel language to describe QoS-oriented SLA associated with cloud services [23]; (ii) a SLA-driven capacity planning for cloud applications [24].

8.1.1.4. SONGS (ANR/INFRA)

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

The SONGS project (Simulation of Next Generation Systems) is an ANR/INFRA project running for 48 months (starting from 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. Each type of large-scale computing system will be addressed through a set of use cases and lead by researchers recognized as experts in this area. The ASCOLA involvement will start in 2013 with the arrival of Takahiro Hirofuchi from the AIST institute in Japan.

8.1.2. FUI

8.1.2.1. Cool-IT (FUI)

Participant: Jean-Marc Menaud [coordinator].

The Cool-IT project is an (industrial) FUI project running for 24 months. It was accepted in September 2010 for funding amounting to 130 KEUR (ASCOLA only).

The objective of this project is to design systems adapted to new standards of "Green IT" to reduce the data centers electrical consumption.

To this end, the COOL IT project will develop processes for cooling computer servers, optimize the server power chain supply, implement tools and methods of collecting energy data in real time, and specify methods for controlling the data centers consumption as a tradeoff between the computational power needed, the availability, and the energy consumption.

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).

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. A4Cloud: Accountability for the Cloud (Integrated Project)

Participants: Mario Südholt [coordinator], Omar Chebaro, Ronan-Alexandre Cherrueau, Rémi Douence, Hervé Grall, Jean-Claude Royer.

The A4Cloud project 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 will create solutions to support users in deciding and tracking how their data is used by cloud service providers. By combining methods of risk analysis, policy enforcement, monitoring and compliance auditing with tailored IT mechanisms for security, assurance and redress, A4Cloud aims to extend accountability across entire cloud service value chains, covering personal and business sensitive information in the cloud.

8.2.2. Collaborations in European Programs, except FP7

8.2.2.1. SCALUS: SCALing by means of Ubiquitous Storage (MC ITN)

Participants: Adrien Lèbre [coordinator], Mario Südholt, Gustavo Bervian Brand.

The vision of the Scalus Marie Curie international training network (MC ITN) is 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. The consortium will proceed into this direction by building the first interdisciplinary teaching and research network on storage issues. It consists of top European institutes and companies in storage and cluster technology, building a demanding but rewarding interdisciplinary environment for young researchers.

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

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

8.2.2.2. COST IC0804

Program: Energy efficiency in large scale distributed systems

Project acronym: COST IC0804

Project title: Energy efficiency in large scale distributed systems

Duration: Jan. 2009 - May 2013

Coordinator: Jean-Marc Pierson (IRIT, France)

Participating countries: AT, BE, CH, CY, DE, DK, EE, FI, FR, GR, HU, IE, IL, IT, LU, PL, PT, RO, SE, SP, TR, UK,

Abstract: The COST IC 0840 Action will propose 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 drastically 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, networks and applications. The action will characterize the energy consumption and energy efficiencies of distributed applications. <http://www.cost804.org/>

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. RAPIDS

Title: Reasoning about Aspect-oriented Programs and security In Distributed Systems

Inria principal investigator: Jacques Noyé

International Partner (Institution - Laboratory - Researcher):

University of Chile (Chile) - PLEIAD - Éric Tanter

Duration: 2010 - 2012

See also: <http://rapids.gforge.inria.fr/doku.php>

While Aspect-Oriented Programming offers promising mechanisms for enhancing the modularity of software, this increased modularity raises new challenges for systematic reasoning. This project studies means to address fundamental and practical issues in understanding distributed aspect-oriented programs by focusing on the issue of security. To this end, the project tackles three complementary lines of work: 1. Designing a core calculus to model distributed aspect-oriented programming languages and reason about programs written in these languages. 2. Studying how aspects can be used to enforce security properties in a distributed system, based upon guarantees provided by the underlying aspect infrastructure. 3. Designing and developing languages, analyses and runtime systems for distributed aspects based on the proposed calculus, therefore enabling systematic reasoning about security. These lines of work are interconnected and confluent. A concrete outcome of RAPIDS will be prototypes for two concrete distributed aspect-oriented extensions of languages increasingly used by current practitioners: Javascript and Java/Scala.

8.4. International Research Visitors

8.4.1. Internships

Rahma CHAABOUNI (from April 2012 until June 2012)

Subject: Flexible evolution of service-oriented systems

Institution: ENIS school, Sfax, Tunisie

Ismael FIGUEROA (from May 2012 until Jul 2012)

Subject: Exploring membranes for aspect oriented programming

Institution: University of Chile (Chile)

ATLANMOD Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Program: Pays de la Loire regional funding. Call: Soutenir et accompagner la constitution et/ou l'implantation de nouvelles équipes sur des thématiques émergentes

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.

Program: Pole de competitivite Images et Reseaux - Appel Projets PME 2011

Project title: StreamMaster

Duration: 2012 - 2014

Coordinator: Data Syscom

Other partners: Research and University (Universite de 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 tatoeing, an innovative and multimodal HMI.

8.2. National Initiatives

8.2.1. ANR

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 Enterprise 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.

8.3. European Initiatives

8.3.1. FP7 Projects

Title: Advanced software-based seRvice provisioning and migraTion of legacy Software

Type: FP7, COOPERATION (ICT)

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

Instrument: Integrated Project (IP)

Duration: October 2012 - September 2015

Coordinator: Atos Origin R&I (Spain)

Others partners: Tecnalía (Spain), Inria (France), Fraunhofer (Germany), TUWIEN (Austria), ENG (Italy), ICCS (Greece), SPARX (Austria), ATC (Greece), SPIKES (Belgium)

See also: <http://www.artist-project.eu/>

Abstract: Successful software has to evolve to keep it compatible and up to date. Up to 90% of software cost is spent on maintenance and of this 75% is spent on the development of new features for staying competitive. The industry progresses through periods of incremental development interlaced with true paradigm shifts. Accordingly, more and more traditional software vendors notice the need to transform their current business and technology model in order to remain competitive. Software-as-a-Service (SaaS) is seen as the most promising way to achieve this change. However, this transition from Software-off-the-shelf (often residing as legacy applications) to SaaS is a tremendous challenge comprising business, application and technical issues. Having an automated, vendor, technology and hardware independent way to migrate an application would permit the software to evolve easily even in case of transition to new paradigms. ARTIST proposes a software migration approach covering the premigration and postmigration phases. The premigration phase analyzes the technical and non-technical consequences of migrations, supporting the decision-making process on how a migration should be done. The migration phase itself is based on Model Driven Engineering techniques to automate the reverse engineering of the legacy applications to platform independent models. These models are the input for the forward engineering process to generate and deploy modernized applications and to support future migrations. In the postmigration

phase, the modernized applications are certified with respect to the stated goals of the premigration phase. ARTIST will reduce the risk, time and cost of migrating legacy software. It will lower the barriers for companies (with existing software) wanting to take advantage of the latest technologies and business models, particularly when considering the current benefits of Cloud Computing and SaaS.

Title: Cost-Efficient methods and processes for SAFETY Relevant embedded systems

Program: Artemis

Project acronym: CESAR

Duration: 2009 - 2012

Coordinator:

Other partners: More than 50 partners

Abstract: The three transportation domains, automotive, aerospace, and rail, as well as the automation domain share the need to develop ultra-reliable embedded systems to meet social demands for increased mobility and safety in a highly competitive global market. To maintain the European leading edge position in the transportation as well as automation market, CESAR aims to boost cost efficiency of embedded systems development and safety and certification processes by an order of magnitude. CESAR pursues a multi-domain approach integrating large enterprises, suppliers, SME's and vendors of cross sectoral domains and cooperating with leading research organizations and innovative SME's. In particular, we work on the Reference Technology Platform, which aims at tool integration. We propose to achieve tool integration by means of metamodeling and model transformations [42]. In the context of this project we are developing VirtualEMF (<http://code.google.com/a/eclipselabs.org/p/virtual-emf/>), an approach and tool for the transparent composition, weaving and linking of heterogeneous models.

Title: Open Platform for the Engineering of Embedded Systems

Program: ITEA2

Project acronym: OPEES

Duration: 2009 - 2012

Coordinator: Obeo

Other partners: Many other research labs and companies. Our main partner was the Obeo company.

Abstract: OPEES (<http://www.opees.org>) mission statement is to settle a community and build the necessary means and enablers to ensure long-term availability of innovative engineering technologies in the domain of dependable or critical software-intensive embedded systems. In particular, within OPEES, our schema of open source industrial collaboration [3] (e.g. around ATL) will be tested and developed as a team contribution to this project. AtlanMod is also responsible for providing a model-driven interoperability solution for the integration of the ecosystem of OPEES components, based on metamodeling the domain data of each component and bridging, by model transformation, the specific data representations.

8.3.2. Collaborations in European Programs, except FP7

Program: Leonardo da Vinci (LifeLong learning programme)

Project acronym: MDEExpertise

Project title: Exchanging knowledge, techniques and experiences around Model Driven Engineering education

Duration: 2010 - 2012

Coordinator: Lublin University of Technology

Other partners: Politecnico di Milano, Universidad de Alicante

Abstract: MDE Expertise (<http://www.learnMDE.org>) is an European Leonardo da Vinci project focused on the development of common educational materials for the Model Driven Engineering (MDE) area. The main aim of the project is to transfer and adapt the education in Model Driven Engineering concepts to the local IT education societies of the partner's countries, thus improving the partners' knowledge about up to date current software development methods. This results in the best preparation for professionals competing on the IT market. Direct results include: development of common MDE teaching methods, suited for the partners' local needs and market requirements; creation of teaching materials (with online version) localized for the partners' languages and definition of tools for e-learning and knowledge exchange. Indirect effects include improving the capability of local SMEs in solving complex software design problems through modeling, and evolving the software development job market.

8.4. International Initiatives

8.4.1. Inria 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

With all three teams we have published several papers and made research visits this year.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

In 2012 the following visitors did a research stay with AtlanMod:

- Ralf Lammel (University of Koblenz-Landau, Germany), February
- Soichiro Hidaka (National Institute of Informatics (NII), Tokyo, Japan), September
- David Ameller (Universitat Politècnica de Catalunya), June
- Juan Manuel Doderó (University of Cádiz, Spain), June
- Jokin García (University of Basque Country, Spain), May-August

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 mutualized 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 study is conducted in cooperation with Télécom Bretagne and Université de Rennes 1.

- **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 card 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 hybride approach should reduce the number of verifications performed at run time.

This study is conducted in cooperation with other Inria Teams (Ascola and Celtique).

8.2. National Initiatives

8.2.1. ANR

- **ANR ARPEGE Project: DALI (2009-2012) - <http://dali.kereval.com/>**

DALI aims at developing innovative design solutions to enhance the capabilities of current intrusion detection systems at the application level as well as new methodologies and tools for assessment and evaluation of the proposed solution with respect to their ability to detect potential intrusions. This project is led by Kereval and involves Supélec, Télécom Bretagne, and the LAAS/ CNRS.

Our activity consists in the design and development of a mechanism to discover invariants in web applications. These invariants are weaved in the application source code, in order to be dynamically checked at runtime. The approach has been applied on an e-commerce application. The assessment phase which has been carried out by the LAAS-CNRS demonstrated a good detection rate of our mechanisms. This projet has been evaluated during the ANR « Grand Colloque STIC » January 2012 and has reached an end in June 2012.

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

Situated in the ubiquitous 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 1, 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 Worldline, CryptoExperts, ENSI Bourges, ENSI Caen, MoDyCo, Oberthur Technologies, NEC Corporation, Microsoft and Université de Rennes 1.

8.2.2. Inria Large-scale Actions

- **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, CNRS, Université de Rennes 1, 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 1, Inria and Supélec.

8.2.4. Competitiveness Clusters

The following projects are recognized by the Images & Réseaux cluster:

- DALI (ANR ARPEGE 2008): <http://www.images-et-reseaux.com/en/content/dali>
- AMORES (ANR INS 2011): <http://www.images-et-reseaux.com/en/content/amores>

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: EIT KICs

Project acronym: EIT ICT Labs

Project title: action line « Security, Privacy and Trust in the Information Society »

Duration: 2012-

Coordinator: Sébastien Gambs (until September 2012 and since then Guido Bertoni, STMicroelectronics)

Abstract: Information Technologies have invaded many aspects of people's daily lives, creating new possibilities but also raising concerns in term of privacy and trust. Protecting the privacy of individuals is one of the main challenges of the Information Society but it is difficult to achieve as individuals constantly leave digital traces of their lives, often without even being aware of this. If an unauthorized entity gathers these digital traces, he (or she) can use them for malicious purposes ranging from targeted spam to profiling, and even identity theft. From the technology viewpoint, a number of Privacy Enhancing Technologies (PETs) and Privacy Aware Architectures have been proposed. So far, these technologies have not stimulated a strong public interest and are not widely used yet. However, the European Commission is putting forward the "privacy by design" principle, which integrates the privacy issues in the design phase of a system or application.

Security and trust can be seen as complementary requirements to privacy. Large scale adoption of digital devices, like in eHealth and smart cities, requires trustworthy products and communication. These requirements are not (always) completely understood and off-the-shelf solutions could not fulfill the security, trust and privacy needs. There is a large gap between what is applied, usability requirements and the right level of security. This gap represents a strategic opportunity where European players have a recognized know-how and where leadership should be leveraged and nurtured.

While the action line was originally intended to focus on privacy (created by a joint effort from Sébastien Gambs, Daniel Le Métayer and Claude Castelluccia from Inria Rhône-Alpes), its scope was recently extended to include security and trust thus being renamed as "Security, Privacy and Trust in the Information Society". In 2012, a "location privacy" activity led by Sébastien Gambs was created that involves CIDRE and other partners (namely KTH, Alcatel-Lucent, University of Trento, Inria Rhône-Alpes, Nokia) coming from 3 different nodes of EIT ICT labs. An engineer funded by the project (Izabela Moise) is currently working on the development of a distributed version of GEPETO based on the MapReduce paradigm and the Hadoop framework, in order to make it able to deal with datasets composed of millions of mobility traces. In 2013, this activity will be extended to also address the issues of privacy and security for location-based services, thus being renamed "Security and privacy for location-based services".

8.3.2. Collaborations with Major European Organizations

Quaero

CIDRE is involved in the Quaero project. Quaero is a program promoting research and industrial innovation on technologies for automatic analysis and classification of multimedia and multilingual documents. The partners collaborate on research and the realisation of advanced demonstrators and prototypes of innovating applications and services for access and usage of multimedia information, such as spoken language, images, video and music. The Quaero consortium (composed of French and German public and private research organisations) is coordinated by Technicolor.

Our activity focuses on a task (led by Amedeo Napoli, équipe Inria Orpailleur) of the Quaero project whose aim is to study the implications in terms of privacy for a user to participate in personalized applications (such as video-on-demand) adapted to the user context, background and preferences as well as proposing solutions that can contribute to enhance this privacy. On one hand using personal data to tailor the content to the user needs may be important for improving the quality of service and its relevance but on the other hand this raises serious privacy issues regarding how this

data will be collected, used and disseminated. The main purpose of the solutions developed in this task is to enable an individual to access personalized content/service in a privacy-preserving manner and without having to disclose any unnecessary personal information. From November 2011 until November 2012, Julien Lolive has worked on the project as an engineer. Izabela Moise has also joined the Quaero project since October 2012.

8.4. International Initiatives

8.4.1. Inria International Partners

CANADA: Sébastien Gambs was co-supervising Ai Thanh Ho, a PhD student from the Université de Montréal with whom he has been actively collaborating since many years on the subject of privacy issues in social networking sites. The main supervisor of Ai Thanh Ho is Esmâ Aïmeur (full professor, Université de Montréal). Ai Thanh Ho has successfully defend her PhD thesis in June 2012.

AUSTRALIA: With Queensland University of Technology (QUT, Brisbane) we cooperate to study policy-based intrusion detection problems. The PhD thesis of Christophe Hauser, “Détection d’intrusions dans les systèmes distribués”, started in october 2009, is supervised jointly with Queensland University of Technology, Brisbane, Australia. From February 2011 to February 2012, Christopher Hauser has worked in Brisbane. His one year visit was supported by a grant from Rennes Métropole.

STIC Algeria (Program Inria/DGRST, 2011-2013): This cooperation project is managed by Adlen Ksentini (member of the Inria Project DIONYSOS, Rennes) and Abdelouahid Derhab (member of CERIST, Centre de Recherche sur l’Information Scientifique et Technique, Alger). This collaboration aims at defining new protocols for data collecting in Wireless Sensor Networks, and evaluate them with the senslab platform. After validating the proposed protocols, CERIST intends to deploy them in the context of the project (Algerian) “Sensirrig”, which aims at using sensors for agricultural irrigation. With L. Zeghache and N. Badache (CERIST), we investigate the use of Mobile Transactional Agents.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

CANADA: Jean-Marc Robert, Professor Professor of ETS (École de Technologie Supérieure) at Montreal was visiting us during a period of four months (September 2012 - December 2012). The joint works focus mainly on privacy in pro-active ad hoc routing protocols. Based on the OLSR protocol, we have proposed a privacy preserving ad hoc proactive routing protocol that preserves the anonymity of the participants, and assure the unlinkability of two different packet flows between two given nodes.

8.5.2. Internships

CHINA: Chuanyou Li, PhD student at Southeast University (Nanjing, China) was visiting us during a period of one year (december 2011 - november 2012). Since the end of a LIAMA project (2000-2002), strong relationships are maintained with the research team of Prof. Yun Wang of Southeast university. The joint works focus mainly on fault-tolerance in distributed systems and security in ad hoc networks.

DIONYSOS Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. ARED Région Bretagne

Participant: Bruno Tuffin.

ARED contract (with Région Bretagne) for the PhD thesis of Sagga Samira on rare event simulation with applications in telecommunications.

7.2. National Initiatives

7.2.1. ARC MENEUR

Participant: Bruno Tuffin.

We coordinate an Inria Cooperative Research Action on Network Neutrality, called MENEUR (“Modélisation en Économie des réseaux et NEUtRalité du Net”). This action runs over 2011–2012 with Inria teams MAE-STRO and MESCAL, Orange Labs, ALU-Bell Labs France, Telecom Bretagne, FTW (Austria), Columbia University and Penn State University.

The goal of this project is to study the interest of network neutrality, a topic that has recently gained a lot of attention. The project aims at elaborating mathematical models that will be analyzed to investigate its impact on users, on social welfare and on providers’ investment incentives, among others, and eventually propose how (and if) network neutrality should be implemented.

See http://www.irisa.fr/dionysos/pages_perso/tuffin/MENEUR/

7.2.2. ANR CAPTURES

Participant: Bruno Tuffin.

We coordinate the ANR Verso CAPTURES: Competition Among Providers for Telecommunication Users: Rivalry and Earning Stakes.

ANR project Dec. 2008- Nov. 2012, in cooperation with Telecom Bretagne and France Telecom R&D.

The goal of this project is to deal with competition among providers in telecommunications. We need to study the distribution of customers among providers as a first level of game, and then to focus on a second higher level, the price and QoS war. See <http://captures.inria.fr/>

7.2.3. ANR VIPEER

Participants: Yassine Hadjadj-Aoul, Gerardo Rubino.

VIPEER is a 3-year ANR project (end 2009-end 2012). VIPEER stands for Video Traffic Engineering in an Intra-Domain Context using Peer-to-Peer Paradigms. The VIPEER project proposes to develop a distributed Content Delivery Network (dCDN) that combines classic CDN technologies with P2P concepts. Our main application in the project is IPTV. Dionysos will mainly cover the QoE assessments activities of VIPEER. Our partners are Télécom Bretagne, Eurecom, Envivio, Orange Labs and NDS Technologies.

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. FP7 PROBE-IT

Participants: César Viho, Nanxing Chen, Arulnambi Nandagoban, Anthony Baire.

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

7.3.2. Collaborations in European Programs, except FP7

7.3.2.1. NoE EuroNF

Participants: Gerardo Rubino, Bruno Tuffin.

EuroNF Euro-NF is a Network of Excellence on the Network of the Future, formed by 35 institutions (from the academia and industry) from 16 countries. Its main target is to integrate the research effort of the partners to be a source of innovation and a think tank on possible scientific, technological and socio-economic trajectories towards the network of the future. It has started in January 2008 and is ended in June 2012 (see http://euronf.enst.fr/en_accueil.html) .

Bruno Tuffin is the Inria team leader in this project.

The group is contributing to the following working packages (Joint Research Activities):

- WP.JRA.2.2: Traffic Engineering, Mechanisms and Protocols for Controlled Bandwidth Sharing;
- WP.JRA.2.4: Routing and Traffic Management in a Multi-Provider Context;
- WP.JRA.2.5: Design of Optimal Highly Dependable Networks;
- WP.JRA.3.2: SLAs, Pricing, Quality of Experience;
- WP.JRA.3.3: Cost Models.

7.3.2.2. INNIS project

Participant: Bruno Tuffin.

Program: Euro-NF NoE

Project acronym: INNIS

Project title: Impacts of Network Neutrality on the Internet Stakeholders

Duration: November 2011 – June 2012

Coordinator: Bruno Tuffin, Dionysos

Other partners: TELECOM Bretagne, the polytechnic University of Valencia (Spain), the University of Rome 2, and the Italian Data Protection Authority

7.3.3. Collaborations with Major European Organizations

Partner 1: FTW, Vienna (Austria)

We work with FTW on network economics.

Partner 1: Vrije University (The Netherlands)

We work with Vrije University on rare event simulation.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. 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.

7.4.2. Inria International Partners

Our other main international partners are:

- José Blanchet (from Columbia University) and Peter Glynn (from Stanford University), on rare event simulation
- 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
- Tarik Taleb (from NEC Europe), on LTE issues
- Alan Krinik (from CalPoly, California, USA), on transient analysis of Markovian queues
- Reinaldo Vallejo (from UFSM, Valparaíso, Chile), on solving techniques for Markov models

7.4.3. CNRS/NFSC IRON

Title: Ensuring Interoperability of new generation networks (IRON)

Principal investigator: César Viho

International Partner:

Institution: BUPT Beijing Univ. of Post and Telecommunication (China)

Inria: Dionysos

Researcher: Pr. Xiaohong Huang

Duration: 01/01/2012 - 31/12/2012

Abstract: Future networks will continue to be heterogeneous. The risk of non-interoperability will increase. This may lead to unavailability of some critical network services, for instance in emergency management, etc. It is important to guarantee that network components will interoperate. One important way among others is to provide efficient testing methodology that help in guaranteeing interoperability of the underlying protocols. The classical testing approach of a single testing system dealing with all tested components and the test execution is no more applicable. To be more confident in the real interoperability of these components, testing has to be done in a close to real operational environment that may be unreliable. Thus, this project aims at providing interoperability testing solutions for distributed communicating systems in unreliable environments.

7.4.4. Participation In International Programs

7.4.4.1. STIC Algérie

Program: DGRSDT Inria Algeria

Title: Réseaux de capteurs

Inria principal investigator: Adlen Ksentini

International Partner (Institution - Laboratory - Researcher):

Centre de Recherche sur l'Information Scientifique et Technique (Algeria)

Duration: Jan 2011 - Dec 2012

7.5. International Research Visitors

7.5.1. Visits of International Scientists

7.5.1.1. Professors

Pr. Xiaohong Huang

Subject: Ensuring Interoperability of new generation networks (IRON)

Institution: BUPT Beijing Univ. of Post and Telecommunication (China)

Duration: 15/09/2012 - 30/09/2012

7.5.1.2. Internships

Leila GHAZZAI (from Feb 2012 until Aug 2012)

Subject: Caching strategies for adaptive video streaming over Content Centric Networks

Institution: Ecole Nationale des Sciences de l'Informatique (Tunisia)

Abhimanyu PANWAR (from May 2012 until Jul 2012)

Subject: Video on Demand over a distributed Content Distribution Network

Institution: IIT Bhubaneswar (India)

DISTRIBCOM Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. ESTASE

Participant: Axel Legay.

- Title: Estase
- Type: Regional project
- Defi: New techniques for statistical model checking
- Instrument: Regional project
- Duration: March 2011 - February 2014
- Coordinator: Inria Rennes

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. IMPRO

Participant: Loïc Hélouët.

Title: IMPRO

Type: ANR

Defi: Implementability and Robustness of Timed Systems

Duration: march 2011 - march 2014

Coordinator: IRCCYN Nantes

Others partners: IRCCyN (Nantes), IRISA (Rennes), LIP6 (Paris), LSV (Cachan), LIAFA (Paris), LIF (Marseilles)

See also: <http://anr-impro.irccyn.ec-nantes.fr/>

Abstract: 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 their good properties. We will first define a generic mathematical framework to reason about and measure implementability, and then study the possibility to integrate implementability constraints in the models. We will particularly focus on the combination of several sources of perturbation such as resource allocation, the distributed architecture of applications, etc. We will also study implementability through control and diagnostic techniques. We will finally apply the developed methods to a case study based on the AUTOSAR architecture, a standard of the automotive industry.

8.3. European Initiatives

8.3.1. DISC

Participant: Eric Fabre.

The DISC Eu project (STREP) officially ended in Dec. 2011, and the final review took place in Feb. 2012. This project was oriented toward the development of supervision and control methods for large systems. Inria was involved in particular for the diagnosis of stochastic systems, and for distributed planning methods. These activities are still going on, with several publications in 2012 and others in preparation. Among the salient facts related to DISC in 2012 were Loig Jezequel's PhD defense (Dec. 2012), and the contribution to 2 chapters of the book "Control of discrete-event systems" seatzu:silva:vanschuppen:2013, to appear in 2013.

8.3.2. Sys2SOFT

Participant: Axel Legay.

Title: SyS2SOFT

Type: Grand emprunt

Defi: Designing for adaptability and evolution in systems of systems engineering

Instrument: Grand emprunt

Duration: Juin 2012 - Mai 2015

Coordinator: DASSAULT

8.3.3. FP7 Projects

8.3.3.1. Dali

Participant: Axel Legay.

- Title: Dali
- Type: COOPERATION (ICT)
- Defi: design of a device for assisted living.
- Instrument: Strep.
- Duration: November 2011 - October 2014
- Coordinator: Trento (Italy)

8.3.3.2. DANSE

Participant: Axel Legay.

Title: DANSE

Type: COOPERATION (ICT)

Defi: Designing for adaptability and evolution in systems of systems engineering

Instrument: Integrated Project (IP)

Duration: November 2011 - October 2014

Coordinator: OFFIS (Germany)

Abstract: DANSE represents the next step in research about component based design and it is thus central in our research activities. The purpose of this project is the development of a new methodology for the design of Systems of Systems (SoS). SoS are modeled using the UPDM Language. In these settings, Statistical Model Checking is the solution to evaluate the SoS capabilities to ensure some properties. During the first period (Nov. 2011 - Nov. 2012), we and ALES company both worked to interface PLASMA and DESYRE to provide the first statistical model-checker tool for the UPDM modeling framework. PLASMA-DESYRE is available and run under the Eclipse environment. To obtain the first prototype of PLASMA-DESYRE we provide a new release of Plasma. It is specially designed to perform SMC using different simulation engines, by reducing the adaptation effort: it can be connected to DESYRE, SciLab, MatLab, and some simulators dedicated to Bio or Prism languages. We also extended UPDML specification with a new contract language designed to specify some requirements. These requirements are viewed as behavioral objectives that lead the system architect for designing some good strategies of the SoS. These requirements (called contracts) are written in English using some patterns that are simple to handle and have a strong semantics

expressed with the Bounded Linear-Temporal-Logic (B-LTL), the property language of PLASMA. This new language is defined using the standard OCL language to define state constraints of the SoS, English temporal patterns that overlay the state constraints to specify some contracts about the behavior of the SoS. It adds the time support that is not initially provided by OCL. These contracts are then compiled into B-LTL formulas and checked by PLASMA-DESYRE, the SoS Statistical Model Checker, against a compiled implementation of the UPDM model. The result estimates the satisfiability of the contract, e.g. the probability that the model satisfies the contract.

8.3.3.3. *UniverseSelf*

Participant: Eric Fabre.

Title: UniverseSelf

Type: COOPERATION (ICT)

Defi: The Network of the Future

Instrument: Integrated Project (IP)

Duration: September 2010 - August 2013

Coordinator: Alcatel Lucent (France)

Others partners:

Universiteit Twente,

Alcatel Lucent Ireland,

Alcatel Lucent Deutschland,

Valtion Teknillinen Tutkimuskeskus (Finland),

University of Piraeus,

France Telecom,

Telecom Italia,

National University of Athens,

Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung,

Interdisciplinary Institute for Broadband Technology,

Telefonica Investigacion y Desarrollo,

Thales Communications,

Inria,

Nec Europe,

University of Surrey,

University College London

IBBT (Belgium).

See also: <http://www.universe-self-project.eu/>

Abstract: UniverSelf unites 17 partners with the aim of overcoming the growing management complexity of future networking systems, and to reduce the barriers that complexity and ossification pose to further growth. UniverseSelf has been launched in October 2010 and is scheduled for four years.

8.3.3.4. *SENSATION*

Participant: Axel Legay.

- Title: Sensation
- Type: COOPERATION (ICT)
- Defi: Study of new techniques for energy saving
- Instrument: Strep.
- Duration: October 2012 - September 2015
- Coordinator: Aalborg (Denmark)

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. FOSSA

Participants: Claude Jard, Albert Benveniste.

The associated team FOSSA studies the **formalization of service orchestrations in the open world** of the Internet. The original FOSSA consortium involved two teams on the Inria side, namely Distribcom (Albert Benveniste and Claude Jard, Rennes, leader of FOSSA) and Mexico (Stefan Haar, Saclay). In early 2011, both teams agreed that Mexico did not have the resources to participate in FOSSA at an appropriate level. So they agreed that Mexico would no longer participate in FOSSA. The team of Cook and Misra at the Computer Science Department, University of Texas at Austin, is among the leading teams on wide area distributed systems and programming. Jayadev Misra ¹ has a long record of results tracing back to the 1980's with his work on the Unity language. Since 2000, he and William Cook are committed to the design and development of the ORC² script language for composite services over the Web. This team is therefore the premier player in this area, combining both a strong theoretical research and a professional tool development. Since his launching in 2004, the DistribCom ³ Inria team, with Albert Benveniste, Claude Jard, and Loïc Hérouët, is involved in the study of Quality of Service (QoS) issues in service orchestrations as well as document based workflows. FOSSA was started with the overall objective of enhancing ORC with the advances performed by DistribCom on the above two subjects.

FOSSA has lived from 2010 to 2012. QoS weaving was the main topic developed in 2012. John Thywissen (Austin side), Ajay Kattapur and Claude Jard (Inria side) were the principal contributors. The strategy was to first focus on causality tracking. This has been implemented in ORC using transformations in the OIL intermediate form. Causality has then been extended with QoS and implemented. A joint paper is under finalization. This year, we have also worked on a joint general paper on the overall approach. On the topic of Active XML and ORC integration, the team has decided to put energy on the development of the AXML REST platform developed by Loïc Hérouët and Benoît Masson (post-doctorate). This platform is a natural candidate for integrating AXML+ORC, as we think. But the cooperative work has not really started, due to overload of the corresponding teams.

8.4.2. Inria International Partners

Distribcom has lively collaboration with the National University of Singapore, where Blaise Genest spent the last 3 years. We also have long lasting collaboration with the Chennai Mathematical Institute.

8.4.3. Participation In International Programs

8.4.3.1. Danish-French collaboration

Program: Action des ambassades de France
 Title: Modular design and verification of stochastic systems
 Inria principal investigator: Axel LEGAY
 International Partner (Institution - Laboratory - Researcher):
 University of Aalborg (Denmark)
 Duration: Jan 2010 - Dec 2012

8.4.3.2. Tournesol (Belgium)

Program: PHC
 Title: Vérification de lignes de produits logiciels
 Inria principal investigator: Axel LEGAY

¹<http://www.cs.utexas.edu/~misra/>

²<http://orc.csres.utexas.edu>

³<http://www.irisa.fr/distribcom/>

International Partner (Institution - Laboratory - Researcher):

University of Namur (Belgium)

Duration: Jan 2011 - Dec 2012

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Narayan K. Kumar and Madhavan Mukund from the Chennai mathematical institute visited Dostribcom in april (1 week each) to continue working on session models in web services, and to launch new research on robustness in distributed systems.

Danilo Ardagna visited Distribcom in October 2012

Prof. Michele Pinna (niv. Cagliari) visited DistribCom from Sept. 1 to Sept. 30.

Andrzej Wasowski visited Distribcom in February 2012 Jan Kretiensky visited Distribcom in September 2012

8.5.1.1. Internships

Guillaume Aucher supervised the internship of Himani Rajora (IIT, Delhi, India) entitled "Distances between Kripke models".

Axel Legay supervised the internship of Alessio Colombu (Trento), Hoa Lee (Trento), and Fabrizio Biondi (ITU Copenhagen).

8.5.2. Visits to International Teams

Guillaume Aucher has visited Thomas Bolander (DTU, Copenhagen) the last week of August 2012. The collaboration was very fruitful and has resulted in significant results related to epistemic planning (DEL) (to be submitted).

Guillaume Aucher visited Leon van der Torre at the university of Luxembourg in November 2012. This visit was scheduled at the same time Samir Chopra and Guido Boella were in Luxembourg. Guido Boella is specialist of law and computer science and Samir Chopra is a logician who recently published a book on law and autonomous agents together with the jurist Laurence White. The visit was very instructive and profitable.

Guillaume Aucher was invited (his travel and accommodation expenses have been reimbursed) by Sonja Smets and Alexandru Baltag at the University of Amsterdam the last week of September 2012 to give two seminars at the ILLC and to work in collaboration with them.

Guillaume Aucher was an invited speaker of the workshop "dynamics in logic II" (Lille, March 2012).

Loïc Hérouët spent 10 days in march 2012 at the Chennai Mathematical Institute to pursue collaboration on verification of session models.

Axel Legay was invited researcher at Namur University multiple times. He was also an invited researcher at ITU Copenhagen.

Eric Fabre visited MIT (LIDS) from June 16 to June 20.

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 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 an everyday basis.

8.2. European Initiatives

8.2.1. FP7 Projects

The SCALUS FP7 Marie Curie Initial Training Network (2009–2013). Partners: Universidad Politécnica de Madrid (UPM), Barcelona Supercomputing Center, University of Paderborn, Ruprecht-Karls-Universität Heidelberg, Durham University, FORTH, École des Mines de Nantes, XLAB, CERN, NEC, Microsoft Research, Fujitsu, Sun Microsystems. Topic: scalable distributed storage. We mainly collaborate with UPM (2 co-advised PhD theses).

8.2.2. Collaborations in European Programs, except FP7

CoreGRID ERCIM Working Group, since 2009. The CoreGRID Symposium held in Las Palmas de Gran Canaria, Spain, 25-26 August 2008 marked the end of the ERCIM-managed CoreGRID Network of Excellence funded by the European Commission. There, it was decided to re-launch CoreGRID as a self-sustained ERCIM Working Group covering research activities on both Grid and Service Computing while maintaining the momentum of the European collaboration on Grid research.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. DATA CLOUD

Title: Distributed data management for cloud services

Inria principal investigator: Gabriel Antoniu

International Partner (Institution - Laboratory - Researcher):

Politechnica University of Bucharest (Romania) - NCIT - Valentin Cristea

Duration: 2010 - 2012

See also: http://www.irisa.fr/kerdata/doku.php?id=cloud_at_work:start

Our research topics address the area of distributed data management for cloud services. We aim at investigating several open issues related to autonomic storage in the context of cloud services. The goal is explore how to build an efficient, secure and reliable storage IaaS for data-intensive distributed applications running in cloud environments by enabling an autonomic behavior, while leveraging the advantages of the grid operating system approach.

Our research activities involve the design and implementation of experimental prototypes based on the following software platforms:

The BlobSeer data-sharing platform (designed by the KerData Team)

The XtremOS grid operation system (designed under the leadership of the Myriads Team)

The MonALISA monitoring framework (using the expertise of the PUB Team).

The main results obtained in 2012 are described in Section 6.4 .

8.3.2. Inria International Partners

Politehnica University of Bucharest

8.3.3. Participation In International Programs

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

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

- Robert Ross and Dried Kimpe (Argonne National Lab) visited the KerData team for a week (June 2012) within the framework of our FACCTS project.
- Florin Pop and Ciprian Dobre (Politehnica University of Bucharest) visited the KerData team for a week (June 2012) within the framework of our DataCloud@work Associate Team.

8.4.2. Internships

Elena Burceanu (from February 2012 until June 2012)

Subject: Distributed data storage for context-aware applications

Institution: Politehnica University of Bucharest (Romania)

Vlad Nicolae Serbanescu (from February 2012 until June 2012)

Subject: Distributed data aggregation using the BlobSeer cloud storage service

Institution: Politehnica University of Bucharest (Romania)

Bharath Vissapragada (from February 2012 until June 2012)

Subject: MapReduce data processing on hybrid (cloud/desktop grid) infrastructures

Institution: University of Hyderabad (India)

Mauricio De Oliveira de Diana (June 2012)

Subject: Performance modeling for the BlobSeer storage system

Institution: Master student from Brazil

Sergiu Vicol (June–August 2012)

Subject: Optimizing memory management in Damaris

Institution: Bachelor student from Oxford University. Former awardee of the ENS-Inria Excellence Award for the Laureates of the Romanian Olympiad in Informatics.

Alexandru Farcasanu(June–August 2012)

Subject: Optimizing the DStore in-memory storage system

Institution: Bachelor students from Politehnica University of Bucharest. Former awardee of the ENS-Inria Excellence Award for the Laureates of the Romanian Olympiad in Informatics.

8.4.3. Visits to International Teams

- Viet-Trung Tran visited Microsoft Research Cambridge (Dushyanth Narayanan) for a 3-month internship, funded by MSR.
- Houssein-Eddine Chihoub visited the Polytechnical University of Madrid (Maria Perez) for 3 months, funded by the FP7 SCALUS MCITN project.
- Radu Tudoran visited the ATL Lab at European Microsoft Innovation Center (Aachen Germany) for 3 months, funded by Microsoft.
- Matthieu Dorier visited ANL (Rob Ross, Tom Peterka, Phil Carns) and UIUC (Franck Cappello) for one month, funded by our FACCTS grant.

MYRIADS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. HOCLAWS (2010-2012)

Participants: Thierry Priol, Cédric Tedeschi, Marko Obrovac.

The objective of the HOCLAWS project is to develop a prototype of a middleware system for the distributed execution of chemical programs (targeted for large scale platforms). It partially funds Marko Obrovac's PhD grant.

8.1.2. 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 provide the view of an Operating System as an "Infrastructure as a Service" (IaaS) and even more as a set of adaptable services. The main functionalities of an Operating System such as memory allocation or job scheduling have to be dynamically adapted to cope with the ever changing environment. This project funds 50% of a PhD grant (Djawida Dib).

In 2012, we have worked on the design and implementation of a PaaS framework for scaling up and down virtual clusters under SLA constraints (price and completion time).

8.2. National Initiatives

8.2.1. ECO-GRAPPE ANR ARPEGE Project (2008-2012)

Participants: Eugen Feller, Christine Morin.

The goal of the ECO-GRAPPE project (<http://ecograppe.inria.fr/>) funded under the ANR ARPEGE program is to design, implement and validate energy saving policies in clusters. This project funds a PhD grant (Eugen Feller). Partners involved in the ECO-GRAPPE project are EDF R&D and Kerlabs.

In 2012, we completed the implementation of the energy saving algorithms and mechanisms in Snooze and evaluated them experimentally with an elastic web service [39], [26], [48], [24], [8]. We also studied a fully decentralize approach to VM consolidation [47], [23]

8.2.2. 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 will be conducted in particular with the SALOME platform and TLSE as examples of programming environments and Marcel, DIET and XtreamOS as examples of RMS. Partners involved in the COOP project are the GRAAL and RUNTIME INRIA EPI, IRIT and EDF R&D. This project funds a research engineer (Yann Radenac).

In 2012, we completed the design and implementation of the modifications needed in XtreamOS Grid distributed operating system in order to integrate the CoorM architecture defined by the Avalon Inria team to support dynamic applications.

8.2.3. CLOUD ANR project (October 2011 - September 2012)

Participants: Sajith Kalathingal, Christine Morin.

The CLOUD project aims at extending an XtreamOS Grid with resources dynamically provisioned from IaaS clouds. An algorithm to select resources in a multi-cloud environment will be defined. A prototype based on XtreamOS Grid and OpenNebula and Nimbus clouds will be built. This project is related to the EIT ICT labs activity 10239 on cloud computing. It funds a research engineer.

In 2012, we augmented XtreamOS Grid distributed system with the capability to acquire virtual resources from cloud service providers. To this end, we enable XtreamOS to provision and configure cloud resources both on behalf of a user and of a virtual organization. We implemented our approach as a set of extension modules for XtreamOS and we evaluated the prototype on Grid'5000 experimentation platform using cloud resources provisioned from a private OpenNebula cloud [58], [60].

8.2.4. MIHMES ANR Investissements d'Avenir (January 2012 - December 2018)

Participants: Christine Morin, Yvon Jégou.

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 2012, we collected the requirements from the bio-informatics applications and defined a workplan to experiment them on top of the cloud technologies developed by Myriads project-team.

8.2.5. HEMERA Inria AEN (2010-2013)

Participants: Christine Morin, Yvon Jégou.

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.

In 2012, several members of Myriads project-team performed large scale experiments to evaluate the systems and services they proposed. The results obtained are described in our publications.

8.2.6. Inria ADT Aladdin (2008-2012)

Participants: Ghislain Charrier, 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>). It structures INRIA's leadership role as the institute is present in 8 of the 9 Grid'5000 sites distributed across France.

An executive committee, where each of the 10 project-teams supporting Grid'5000 in the 8 research centers is represented, meets every month. It gives recommendations to the directors on scientific animation, access policy to the instrument as well as for the hardware and software development according to the resources devoted to this ADT. Yvon Jégou represents INRIA Rennes in this executive committee.

The technical team is now composed of 12 engineers, of which 3 are hosted in the Myriads team (David Margery, technical director, (SED² member), Pascal Morillon (SED member), Ghislain Charrier). This technical team is structured in a sysadmin team, managing the instrument, and a development team building the tools to build, execute and analyze experiments.

²The SED is the INRIA Experimentation and Development Service.

8.2.7. Inria ADT XtreamOS Easy (2010-2012)

Participants: Amine Belhaj, Rémy Garrigue, Yvon Jégou, David Margery, Christine Morin.

The XtreamOS EASY technological development action funded by INRIA aims at developing a set of tools and environments to ease the installation, configuration, deployment, experimentation and use of the XtreamOS Grid operating system and at providing support to the XtreamOS open source community. Two associate engineers are involved in this project: Amine Belhaj and Rémy Garrigue. David Margery (SED) is tutoring them in software development.

In 2012, we completed a major release of XtreamOS system for the OpenSuse Linux distribution. We operated the open testbed and built ready-to-use virtual machine images to ease the use of the system. We also provided support to the user community.

8.2.8. Inria ADT DAUM (2011-2012)

Participants: Erwan Daubert, Jean-Louis Pazat.

We participate to the ADT DAUM which is coordinated by the Triskell project-team. DAUM is a Technology Development Action (ADT) by INRIA aiming at providing an integrated platform for distributed dynamically adaptable component based applications. DAUM unites and integrates results and software from the Triskell EPI and the Myriads team. More precisely, DAUM extends the Kevoree component framework designed by Triskell with adaptation mechanisms from the SAFDIS framework designed by Myriads.

DAUM will evaluate this integration by designing a full scale system for a tactical assistant for firefighter officers, in collaboration with the firefighters organization of Ille et Vilaine department (2800 firefighters).

Project duration: October 2011 - September 2012

Triskell budget share: One associated engineer shared with the Triskell EPI

Project Coordinator: Noël Plouzeau, Triskell INRIA Project.

Participants: Myriads, Triskell.

8.2.9. Inria ADT Snooze (2012-2014)

Participants: 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 wider community.

In 2012, we validated Snooze on top of Xen hypervisor. We also started re-implementing Snooze based on the Akka library providing asynchronous data communication. We studied how to re-use in Snooze some OpenStack components such as the image repository storage. We deployed Snooze on multiple sites of the Grid'5000 platform. We implemented the libcloud driver for Snooze.

8.2.10. 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 practices in order to improve the energy efficiency of printers, servers, datacenters, and any ICT equipment in use in public research organizations.

8.2.11. Competitivity Clusters

The COOP ANR project is recognized by the Images & Réseaux cluster.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. S-CUBE

Participants: Erwan Daubert, Guillaume Gauvrit, André Lage, Jean-Louis Pazat, Chen Wang.

Title: S-CUBE

Type: COOPERATION (ICT)

Defi: Service & SW architectures, infrastructures and engineering

Instrument: Network of Excellence (NoE)

Duration: March 2008 - February 2012

Coordinator: Universität Duisburg-Essen (Germany)

Others partners: Tilburg University (The Netherlands), City University London (UK), Consiglio Nazionale delle Ricerche (Italy), Center for Scientific and Technological Research, The French National Institute for Research in Computer Science and Control, Lero - The Irish Software Engineering Research Centre (Ireland), Politecnico di Milano (Italy), MTA SZTAKI - Computer and Automation Research Institute, Vienna University of Technology (Austria), Université Claude Bernard Lyon (France), University of Crete, Universidad Politécnica de Madrid (Spain), University of Stuttgart (Germany)

See also: <http://www.s-cube-network.eu/>

Abstract: S-Cube, the Software Services and Systems Network, will establish an integrated, multidisciplinary, vibrant research community which will enable Europe to lead the software-services revolution, thereby helping shape the software-service based Internet which is the backbone of our future interactive society. An integration of research expertise and an intense collaboration of researchers in the field of software services and systems are needed to address the following key problems:

Research fragmentation: Current research activities are fragmented and each research community (e.g., grid computing or software engineering) concentrates mostly on its own specific techniques, mechanisms and methodologies. As a result the proposed solutions are not aligned with or influenced by activities in r

8.3.1.2. CONTRAIL

Participants: Roberto-Gioacchino Cascella, Florian Dudouet, Filippo Gaudenzi, Piyush Harsh, Yvon Jégou, Christine Morin.

Title: Contrail

Type: COOPERATION (ICT)

Defi: Internet of Services, Software & Virtualisation

Instrument: Integrated Project (IP)

Duration: October 2010 - September 2013

Coordinator: INRIA (France)

Others partners: 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; EBM WebSourcing, France.

See also: <http://contrail-project.eu/>

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 [44], [55].

In 2012, we led the revision of Contrail overall architecture [42]. We also progressed on the design and implementation of VEP advanced features such as the reservation manager and scheduler [43]. We defined a revised version of the API. 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. She leads WP 10. Yvon Jégou leads WP 5 on VEP and WP 13 on testbeds.

8.3.1.3. HARNESS

Participant: Guillaume Pierre.

Title: Hardware- and Network-Enhanced Software Systems for Cloud Computing

Type: COOPERATION (ICT)

Defi: Pervasive and Trusted Network and Service Infrastructures

Instrument: STREP

Duration: October 2012 - September 2015

Coordinator: Imperial College (United Kingdom)

Others partners: École Polytechnique Fédérale de Lausanne, Konrad-Zuse-Zentrum für Informationstechnik Berlin, Maxeler Technologies and SAP AG.

See also: <http://www.harness-project.eu/>

Abstract: Cloud computing systems are currently composed of large numbers of relatively inexpensive computers, interconnected by standard IP routers and supported by stock disk drives. However, many demanding applications have now reached a fundamental limit in their ability to scale out using traditional machines. Future performance improvements will derive from the use of high-end specialized equipment in addition to standard hardware: GPUs of course, but also FPGAs, programmable routers, and advanced storage technologies. In this context the European project HARNESS investigates: (i) how cloud providers may offer such extremely heterogeneous hardware to its users; and (ii) how cloud customers may make use of these heterogeneous resources to run their applications such that they exhibit the best possible price-performance tradeoff.

8.3.1.4. PaaSage

Participants: Christine Morin, Nikos Parlavantzas.

Title: PaaSage - Model-Based Cloud Platform Upperware

Type: ICT

Instrument: Large Scale Integrated Project

Duration: October 2012 - September 2016

Coordinator: ERCIM

Other partners: SINTEF, STFC, University of Stuttgart, CETIC, FORTH, BE.Wan, EVRY Solutions, SysFera, Flexiant, Lufthansa Systems AG, GWDG, Automotive Simulation Center Stuttgart

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

Abstract: Software developers targeting the Cloud want an easy way to develop their software in a fashion that exploits the full potential of the clouds, and still is able to run on any of the available offerings. Current platforms are heterogeneous and tend to impose a specific architecture on deployed applications. Accordingly, there is a significant dependency between client applications and the services provided by the platform. It is generally up to the developer to specify and exploit platform services to her best knowledge. However, the typical developer will neither know how to use these characteristics, nor how they impact on the overall behaviour and, what is more, how they relate to a given Cloud infrastructure. To address this complexity, PaaSage will deliver an open and integrated platform to support model-based lifecycle management of Cloud applications. The platform and the accompanying methodology will allow model-based development, configuration, optimisation, and deployment of existing and new applications independently of the existing Cloud infrastructures.

In 2012, we studied the state of the art and worked on the system requirements and specifications.

8.3.1.5. *Eco2Clouds*

Participants: David Margery, Christine Morin, Anne-Cécile Orgerie, Nicolas Lebreton.

Title: Experimental Awareness of CO₂ in Federated Cloud Sourcing

Type: ICT

Instrument: STREP

Duration: October 2012 - September 2014

Coordinator: ATOS

Other partners: The University of Manchester, EPCC, HLRS, Politecnico Di Milano, Inria.

See also: <http://eco2clouds.eu>

Abstract: The ECO2CLOUD project tackles CO₂ emission awareness in virtualized infrastructures, applying its results to the BonFIRE facility. We specifically tackle the question of predictable costs for the user despite the varying load on the infrastructure and tractable cost models and APIs to enable application deployment optimization and adaptation.

8.3.1.6. *BonFire*

Participants: Maxence Dunnewind, Eric Poupart, Nicolas Lebreton, David Margery, Cyril Rohr.

Title: BonFIRE, Building service testbeds on FIRE

Type: COOPERATION (ICT)

Defi: Future Internet experimental facility and experimentally-driven research

Instrument: Integrated Project (IP)

Duration: June 2010 - November 2013

Coordinator: ATOS SPAIN SA (Spain)

Others partners: The university of Edinburgh (U.K.); SAP AG (Germany); Universitaet Stuttgart (Germany); Fraunhofer-Gesellschaft zur Foerung der Angewandten Forschung 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.) Technische 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 Tecnologico De Supercomputacion De Galicia (Spain); Centre d'Excellence en technologies de l'Information et de la communication (Belgium); University of Manchester (U.K.);

See also: <http://www.bonfire-project.eu/>

Abstract:he BonFIRE (Building service testbeds for Future Internet Research and Experimentation) project will design, build and operate 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.

8.3.1.7. FED4FIRE

Participants: Nicolas Lebreton, David Margery.

Title: Federation for Future Internet Research and Experimentation

Type: ICT

Instrument: Integrated Project

Duration: October 2012 - September 2016

Coordinator: iMinds

Other partners: IT Innovation, UPMC, Fraunhofer, TUB, UEDIN, Inria, NICTA, ATOS, UTH, NTUA, UNIVBRIS, i2CAT, EUR, DANTE Limited, UC, NIA.

See also: <http://www.fed4fire.eu>

Abstract: The key outcome of Fed4FIRE will be an open federation solution supporting all stakeholders of FIRE. Fed4FIRE is bringing together key players in Europe in the field of experimentation facilities and tool development who play a major role in the European testbeds of the FIRE initiative projects.

8.3.1.8. SCALUS Marie Curie Initial Training Networks (MCITN) (2009-2013)

Participant: Christine Morin.

Title: SCALUS - SCALing by means of Ubiquitous Storage

Type: PEOPLE (ICT)

Defi: elevating education, research, and development inside the area of storage architectures with a focus on cluster, grid, and cloud storage

Instrument: Marie Curie Initial Training Networks (MCITN)

Duration: 4 years

Coordinator: Paderborn University, Germany

Others partners: Paderborn Center for Parallel Computing (PC2), Germany ; BSC, Spain ; Durham University, UK ; Goethe Universität Frankfurt, Germany ; FORTH-ICS, Greece ; Universidad Politecnica De Madrid, Spain ; Ecole des Mines de Nantes, France ; XLAB, Slovenia ; Universität Hamburg, Germany ; Xyratex, UK ; Fujitsu Technology Solutions GmbH, Germany (associated partner) ; CERN, Switzerland (associated partner) ; Microsoft Research, UK (associated partner) ; NEC, Germany (associated partner) ; ORACLE, Germany (associated partner).

See also: <http://www.scalus.eu/>

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 the area of storage architectures with a focus on cluster, grid, and cloud storage. The vision of the SCALUS MCITN is to deliver the foundation for ubiquitous storage systems, which can be scaled in arbitrary directions (capacity, performance, distance, security, . . .). The consortium involves 8 full academic partners, 2 full industrial partners and 5 additional associated industrial partners. Christine Morin participates in this project by co-advising with Professor Ludwig from the University of Hamburg a PhD student (Amandine Pignier) working on Load Balancing and Scheduling in Parallel and Cluster File Systems.

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 March 2012, Eugen Feller organized a meeting for the participants in the focus group on "Energy and QoS-Aware Workload Management in Clouds" in Rennes.

8.3.2.2. RMAC

Participants: Ancuta Iordache, Yvon Jégou, Christine Morin, Nikos Parlavantzas.

Program: EIT ICT Labs

Project acronym: RMAC

Project title: Resource Management Across Clouds

Duration: January-December 2012

Coordinator: Dick Epema, TU Delft and TU Eindhoven

Other partners: Institut Telecom, KTH, TU Delft and TU Eindhoven

See also: <http://www.pds.ewi.tudelft.nl/ghit/projects/rmac/>

Abstract: The main goal of this activity is to provide solutions for effective, efficient, elastic resource management across multiple clouds at the IaaS level for a wide range of application types (e.g., applications that fit the MapReduce paradigm and data-intensive applications) in federated public and private cloud infrastructures as extensions of the current systems of the partners.

In 2012, we implemented a new version of Resilin, a software which provides the Amazon Elastic MapReduce API and allows users to leverage resources from one or multiple public and/or private clouds. Resilin is now implemented as a distributed and loosely-coupled system whose business logic is separated into distinct services that can be distributed over the network, combined and reused. We also performed an extensive experimental evaluation conducted on multiple clusters of the Grid'5000 experimentation testbed [59], [31].

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. DataCloud@Work

Participants: Alexandra Carpen-Amarie, Christine Morin.

Title: DataCloud@Work

INRIA principal investigator: Gabriel Antoniu, Kerdata

International Partner: Valentin Cristea

Institution: University Polytechnical Bucharest (UPB)

Laboratory: Team of Prof. Valentin Cristea

Duration: 2010 - 2012

See also: http://www.irisa.fr/kerdata/doku.php?id=cloud_at_work:start

The goal of the Associated team is to study massive data management in cloud based service infrastructures. In this context, the Myriads team is involved in a study aiming at the integration of the BlogSeer large scale storage system in XtremOS distributed system in a vision where XtremOS is used for the management of IaaS clouds.

8.4.2. Participation In International Programs

Since September 2011, Christine Morin has been an affiliate at Lawrence Berkeley National Laboratory working in the Advanced Computing for Science (ACS) department of the Computational Research Division (CRD) headed by Deb Agarwal. She is actively engaged in three research collaborations with ACS personnel including data management frameworks for scientific applications in cloud environments (with Lavanya Ramakrishnan), use of data-mining and machine-learning techniques to improve resource and failure management in large-scale infrastructures (with Taghrid Samak), and providing community access to MODIS Satellite Reprojection and Reduction Pipeline and Data Sets [30](with Valerie Hendrix and Lavanya Ramakrishnan). During her 2-year sabbatical visit at the Lawrence Berkeley National Laboratory, Christine Morin is the scientific manager of the Inria@SiliconValley program [54]. Deb Agarwal visited Myriads team in May 2012. The Dalhis associate team proposal was submitted in September 2012.

8.5. International Research Visitors

8.5.1. Visits to International Teams

Eugen Feller did a 3-month internship at the Lawrence Berkeley National Laboratory from July to September 2012. This internship was partially funded by a fellowship from Ecole Doctorale Matisse. E. Feller has worked with L. Ramakrishnan and C. Morin on the evaluation of Hadoop MapReduce jobs in a virtualized environment.

Héctor Fernández did a 1-month internship at Vrije University in November 2011. This internship was funded by the S-Cube network of Excellence. H. Fernández worked with P. Lago on the simulation through the use of the chemical programming model of Agile Software engineering.

TRISKELL Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR GEMOC

Participants: Benoit Combemale, Didier Vojtisek, Olivier Barais, Arnaud Blouin, 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.

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 provisioning 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, Valéria Lelli, 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 S-CUBE

Title: S-CUBE

Type: COOPERATION (ICT)

Defi: Service & SW architectures, infrastructures and engineering

Instrument: Network of Excellence (NoE)

Duration: October 2008 - March 2012

Coordinator: University of Duisburg-Essen (Germany), Tilburg University (The Netherlands)

Others partners: Tilburg University (The Netherlands), City University London (UK), Consiglio Nazionale delle Ricerche (Italy), Center for Scientific and Technological Research, The French National Institute for Research in Computer Science and Control, Lero - The Irish Software Engineering Research Centre (Ireland), Politecnico di Milano (Italy), MTA SZTAKI - Computer and Automation Research Institute, Vienna University of Technology (Austria), Université Claude Bernard Lyon (France), University of Crete, Universidad Politécnica de Madrid (Spain), University of Stuttgart (Germany)

See also: <http://www.s-cube-network.eu/>

Abstract: S-Cube, the Software Services and Systems Network, will establish an integrated, multidisciplinary, vibrant research community which will enable Europe to lead the software-services revolution, thereby helping shape the software-service based Internet which is the backbone of our future interactive society.

An integration of research expertise and an intense collaboration of researchers in the field of software services and systems are needed to address the following key problems:

- **Research fragmentation:** Current research activities are fragmented and each research community (e.g., grid computing or software engineering) concentrates mostly on its own specific techniques, mechanisms and methodologies. As a result the proposed solutions are not aligned with or influenced by activities in related research fields.
- **Future Challenges:** One challenge, as an example, is to build service-based systems in such a way that they can self-adapt while guaranteeing the expected level of service quality. Such an adaptation can be required due to changes in a system's environment or in response to predicted and unpredicted problems.

Triskell budget share: 150 keuros

8.2.2. FP7 NESSoS

Title: NESSoS

Type: COOPERATION (ICT)

Defi: Service & SW architectures, infrastructures and engineering

Instrument: Network of Excellence (NoE)

Duration: October 2010 - October 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/>

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

8.2.3. CESAR

Title: CESAR

Duration: February 2009 - January 2012

Coordinator: AVL - GmbH (Austria)

See also: <http://www.cesarproject.eu/>

Abstract: In the context of CESAR, we have participated to the sub-project 3 demonstrator in order to demonstrate the usability of Polychrony as a co-simulation tool within the reference technology platform of the project, to which its open-source release has been integrated. The case-study, implemented in collaboration with Airbus and IRIT, consists of co-modeling the doors management system of an Airbus A350 by merging its architecture description, specified with AADL, with its behavioral description, specified with Simulink.

Triskell brings its model-driven engineering expertise to compositionally assemble, compile and verify heterogeneous specifications (AADL and Simulink). Our case study will cover code generation for real-time simulation and test as well as formal verification both at system-level and in a GALS framework. Based on that case study, we aim at developing further modular code-generation services, real-time simulation, test and performance evaluation, formal verification as well as the validation of the generated concurrent and distributed code.

8.2.4. Artemis CHESS

Participants: Noël Plouzeau, Jean-Marc Jézéquel, Jacques Falcou, Viet-Hoa Nguyen.

Real-Time Embedded systems, Component-based Development, Model Driven Engineering

CHES is an Artemis project that seeks industrial-quality research solutions to problems of property-preserving component assembly in real-time and dependable embedded systems, and supports the description, verification, and preservation of non-functional properties of software components at the abstract level of component design as well as at the execution level. CHES develops model-driven solutions, integrates them in component-based execution frameworks, assesses their applicability from the perspective of multiple domains (such as space, railways, telecommunications and automotive), and verifies their performance through the elaboration of industrial use cases.

In 2012 Triskell contributed to final phase of development of the model editor specially built for CHES on top of Papyrus. Using its Kermeta platform, Triskell contributed to the design and implementation of a set of constraint checkers, which ensure that designers define models compliant with the CHES metamodel.

Project duration: 2/2009-4/2012

Triskell budget share: 400 keuros

Project budget: 6 M euros

Project Coordinator: INTECS

Participants: AICAS, Aonix, Atego ENEA, Ericsson, Fraunhofer, FZI, GMV, Inria (Triskell), INTECS, Thales Alenia Space, THALES Communications, UPM, University of Padua, X/Open

8.2.5. ITEA2 OPEES

Program: ITEA2

Project acronym: OPEES

Project title: Open Platform for the Engineering of Embedded Systems

Duration: 2010-2012

Triskell budget share: 150 keuros

Coordinator: OBEO (Gaël Blondelle)

Other partners: AIRBUS, ADACORE, Anyware Technologies, Astrium Satellites, Atos Origin, CEA LIST, CNES, C-S, Dassault, EADS Astrium ST, ENAC, INPT-IRIT, Inria (Atlan-Mod/ESPRESSO/TRISKELL), MBDA, OBEO, ONERA, Schneider Electric, Thales, Xipp

Abstract: OPEES is an ITEA2 project which goal is to build a community able to ensure long-term availability of innovative engineering technologies in the domain of software-intensive embedded systems. Its main benefits should be to perpetuate the methods and tools for software development, minimize ownership costs, ensure independence of development platform, integrate, as soon as possible, methodological changes and advances made in academic world, be able to adapt tools to the process instead of the opposite, take into account qualification constraints. In this purpose, OPEES relies on the Eclipse Modeling Project platform (EMF, GEF, GMF, OCL, UML2, ...) and on many available tools such as Kermeta. The participation of Triskell into the OPEES project aims at industrializing both ModMap and Pramana. ModMap is a method and the associated tool to specify and use alignment rules between both homogeneous and heterogeneous languages. Current use is the creation of adapters between aligned languages. Pramana is a model transformation testing framework that makes it possible to synthesize input data (i.e. test models) for model transformations and check that the transformation behaves "correctly" on them.

8.2.6. 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.

8.2.7. 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 Jyväskylä, 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 tailors 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. Inria International Partners

Following the Diva STREP project, we keep an active collaboration with the SINTEF institute. François Bois Fouquet visited SINTEF for 8 weeks. During this visit, we combined the results of Kevoree and the result of the Moderate from SINTEF project to provide a dynamic component model for a micro-controllers based Internet of Things. Indeed, as the Internet of Things promises new ways for humans to interact with computing systems by seamlessly integrating resource constrained devices and traditional computing environment. These new computing environments are highly volatile and force applications to embed self-adaptive behaviors. The contribution of this collaboration is \mathcal{C}° -Kevoree: a plain C implementation of the Kevoree runtime which can be deployed on poor in resources micro-controllers. Evaluation of memory usage, reliability and performance shows that \mathcal{C}° -Kevoree is a viable solution with strong benefits over adaptation through dynamic firmware upgrades.

Following the MoCAA Equipe associée, we keep an active collaboration with Colorado State University. Benoit Baudry and Benoit Combemale visited CSU in April 2012 and Philippa Bennett spent a 4-months internship in Triskell. We continue the collaboration with Prof. Sanjay Rajopadhye (from the optimizing compiler domain) to cross-fertilize both HPC and MDE. Results of this collaboration were published in the Journal of Software and Systems in October 2012.

8.3.2. Participation In International Programs

8.3.2.1. 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)
Duration: Jul 2011 - Jun 2013

8.3.2.2. SPLIT

Program: PICS International Project of Scientific Cooperation
Title: Combiner les lignes de produits logicielles et le développement logiciel orienté aspects
Inria principal investigator: Jean-Marc JEZEQUEL
International Partner (Institution - Laboratory - Researcher):
University of Luxembourg (Luxembourg)
Duration: Jan 2009 - Dec 2012

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Joerg Kienzle (<http://www.cs.mcgill.ca/~joerg>) - Robert France - Barrett Bryant

8.4.1.1. Internships

Phillipa BENNETT (from Apr 2012 until Sep 2012)
Subject: Model Transformation Testing
Institution: Colorado State University (United States)
Martin FAUNES (from Mar 2012 until May 2012)
Subject: Automated discovery of domain invariants
Institution: Carleton University (Canada)

DREAM Project-Team (section vide)

LAGADIC Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. *FUI Rev-TV project*

Participants: Céline Teulière, François Chapeau, Eric Marchand.

no. Inria Rennes 4549, duration: 36 months.

This project started in January 2010. It is composed of a consortium managed by Technicolor with Artefacto, Istia, Telecom Bretagne, Soniris, Bilboquet and Inria Lagadic and Metiss groups. The goal of this project is to provide tools to develop new TV programs allowing the final user to interact within an immersive and convivial interface. Within this project, we focused on the development of tracking algorithms (3D localization) and on visual servoing techniques for camera localization.

8.1.2. *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 is to develop an augmented reality library for smartphones.

8.1.3. *Apash project*

Participants: Rafik Sekkal, 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 6.3.6 .

8.2. National Initiatives

8.2.1. *DGA/DGCIS Rapid Canari*

Participants: Patrick Rives, Cyril Joly.

no. Inria Sophia 4979, duration : 36 months.

This project started in July 2010. It aims at developing a full autonomous indoor mobile robot dedicated to survey missions. The partners are Robopec and ECA companies. We are in charge of the development of Slam aspects. The contract supported Cyril Joly's engineer grant (see Section 6.3.3).

8.2.2. *ANR Contint Prosit*

Participants: Tao Li, Alexandre Krupa.

no. Inria Rennes 3585, duration: 46 months.

This project is led by the Prisme lab in Bourges. It started in December 2008 in collaboration with LIRMM in Montpellier, LMS in Poitiers, CHU of Tours, and the Robosoft company. Its goal is to develop an interactive master-slave robotic platform for medical diagnosis applications (tele-echography) with assistance functionalities. The work that we have realized within this project is described in Section 6.4.2 .

8.2.3. ANR Contint US-Comp

Participants: Caroline Nadeau, Alexandre Krupa.

no. Inria Rennes 3560, duration: 42 months.

This project, led by Alexandre Krupa, started in December 2008. It involves a collaboration with the Visages team in Rennes, LSIT in Strasbourg and Lirmm in Montpellier. Its goal is to provide methodological solutions for real-time compensation of soft tissues motion during ultrasound imaging. The approach consists in synchronizing the displacement of a 2D or 3D ultrasound probe to stabilize the observed image by the use of a robotic arm. The work that we have realized within this project is described in Sections 6.4.1 and 6.4.3 .

8.2.4. ANR P2N Nanorobust

Participants: Le Cui, Eric Marchand.

no. URI 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.

8.2.5. PEA Decsa

Participants: Aurélien Yol, Eric Marchand, François Chaumette.

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.

8.2.6. Equipex Robotex

Participants: Aurélien Yol, 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. This year, it allowed us to buy the Viper S650 arm and the Pioneer 3DX described in Sections 5.4 and 5.5 . In a near future, we plan to buy a humanoid robot, Romeo, by Aldebaran Robotics.

8.2.7. Inria Large Scale Initiative Action Pal

Participants: Patrick Rives, Marie Babel, François Chaumette, Luca Marchetti, Cyril Joly, Rafik Sekkal, François Pasteau.

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 6.3.6 , 6.2.4 and 6.3.5 .

8.3. European Initiatives

8.3.1. FP7 Regpot Across

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.

8.4. International Initiatives

8.4.1. Participation in International Programs

8.4.1.1. Inria/CNPq MuNave

The project MuNave (2010 - 2012) funded through the Inria/CNPq collaboration framework, succeeds to a long time collaboration between Patrick Rives and the CTI in Campinas (Brazil). This project aims at investigating new research themes in perception and control for autonomous mobile robots.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Shogo Arai, Assistant Prof. at the University of Tohoku in Sendai, Japan, spent a two-month visit in our group in Rennes in March and April 2012 to work on visual servoing.
- Nicolas Alt, Ph.D. student at the Technische Universität München, Germany, visited our group in Sophia Antipolis from July 2 to September 26. He worked on the detection and modeling of transparent objects using a Kinect.
- Rogelio Esteller Curto, Assistant Prof. at the University of Jaume-I in Castellon, Spain, has spent a one-month visit in our group in Rennes in November 2012 to work on visual servoing.

8.5.2. Internships

Thanks to the FP7 Regpot project (see Section 8.3.1), we have got three internships from University of Zagreb from March to June 2012:

- Ante Trbojevic
- Petra Bosilj
- Petar Palasek.

Two internships from the University of Guanajuato started in December 2012:

- Raul Orlando Alvarado Lara
- Francisco Javier Rangel Butanda.

METISS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. National Projects

8.1.1.1. QUAERO CTC and Corpus Projects (OSEO)

Participants: Kamil Adiloglu, Frédéric Bimbot, Laurence Catanese, Gabriel Sargent, Emmanuel Vincent.

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

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).

This program is supported by OSEO. The consortium is led by Thomson. 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.

METISS 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).

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

8.1.1.2. ANR ECHANGE

Participants: Rémi Gribonval, Emmanuel Vincent, Nancy Bertin.

Duration: 3 years (started January 2009). Partners: A. Cohen, Laboratoire J. Louis Lions (Paris 6); F. Ollivier et J. Marchal, Laboratoire MPIA / Institut Jean Le Rond d'Alembert (Paris 6); L. Daudet, Laboratoire Ondes et Acoustique (Paris 6/7).

The objective of the ECHANGE project (EChantillonage Acoustique Nouvelle GÉnération) was to setup a theoretical and computational framework, based on the principles of compressed sensing, for the measurement and processing of complex acoustic fields through a limited number of acoustic sensors.

8.1.1.3. DGCIS REV-TV

Participants: Guylaine Le Jan, Grégoire Bachman, Nathan Souviraà-Labastie, Frédéric Bimbot.

Duration: 2.5 years (2010-2012). Partners: Technicolor (ex Thomson R&D), Artefacto, Bilboquet, Soniris, ISTIA, Télécom Bretagne, Cap Canal

The Rev-TV project aims at developing new concepts, algorithms and systems in the production of contents for interactive television based on mixed-reality.

In this context, the Metiss research group was focused on audio processing for the animation of an avatar (lip movements, facial expressions) and the control of interactive functionalities by voice and vocal commands.

8.1.2. Action de Développement Technologique

8.1.2.1. FASST

Participants: Nancy Bertin, Emmanuel Vincent, Frédéric Bimbot.

Duration: 2 years (2012–2014). Partners: Inria Teams Parole (Nancy) and Texmex (Rennes)

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.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. SMALL

Participants: Rémi Gribonval, Jules Espiau de Lamaestre, Sangnam Nam, Emmanuel Vincent, Nancy Bertin.

Title: Sparse Models, Algorithms and Learning for Large-scale data

Type: COOPERATION (ICT)

Defi: FET Open

Instrument: Specific Targeted Research Project (STREP)

Duration: February 2009 - January 2012

Coordinator: Inria (France)

Others partners: Univ. Edimburg (UK), Queen Mary Univ. (UK), EPFL (CH), Technion Univ. (ISR)

See also: <http://small-project.eu/>

Abstract: The project has developed new foundational theoretical framework for dictionary learning, and scalable algorithms for the training of structured dictionaries.

8.2.1.2. PLEASE

Title: Projections, Learning and Sparsity for Efficient data processing.

Type: IDEAS ()

Instrument: ERC Starting Grant (Starting)

Duration: January 2012 - December 2016

Coordinator: Inria (France)

Principal investigator: Rémi Gribonval

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

8.2.2. Collaborations in other European Programs

Program: Eureka - Eurostars

Project acronym: i3DMusic

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

Duration: October 2010 - September 2013

Other partners: Audionamix (FR), Sonic Emotion (CH), École Polytechnique Fédérale de Lausanne (CH)

Abstract: The i3DMusic project (Real-time Interactive 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 Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. VERSAMUS

Participants: Emmanuel Vincent, Nobutaka Ito, Gabriel Sargent, Frédéric Bimbot, Rémi Gribonval.

Title: Integrated probabilistic music representations for versatile music content processing

Inria principal investigator: Emmanuel Vincent

International Partner (Institution - Laboratory - Researcher):

Tokyo University (Japan) - Department of Physics and Computing

Duration: 2010 - 2012

See also: <http://versamus.inria.fr/>

Music plays a major role in everyday use of digital media contents. Companies and users are waiting for smart content creation and distribution functionalities, such as music classification, search by similarity, summarization, chord transcription, remixing and automatic accompaniment. So far, research efforts have focused on the development of specific algorithms and corpora for each functionality based on low-level sound features characterizing sound as a whole. Yet, music generally results from the superposition of heterogeneous sound components (e.g. voices, pitched musical instruments, drums, sound samples) carrying interdependent features at several levels (e.g. music genre, singer identity, melody, lyrics, voice signal). Integrated music representations combining all feature levels would make it possible to address all of the above functionalities with increased accuracy as well as to visualize and interact with the content in a musically relevant manner. The aim of this project was to investigate, design and validate such representations in the framework of Bayesian data analysis, which provides a rigorous way of combining separate feature models in a modular fashion. Tasks addressed in the project have included the design of a versatile model structure, of a library of feature models and of efficient algorithms for parameter inference and model selection.

MIMETIC Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR Contint: *iSpace&Time*

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

The iSpace&Time project is founded by the ANR and gathers six partners: IGN, Lamea, University of Rennes 1, LICIT (IFSTAR), 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 2013.

7.1.2. ANR Contint: *Chrome*

Participants: Julien Pettré [julien.pettre@inria.fr], Kevin Jordao, Oriane Siret.

Chrome is a national project funded by the French Research Agency (ANR). The 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 through the scope of virtual camera control (Inria Rennes and Grenoble)

7.1.3. 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.

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.

7.1.4. ANR JCJC: *Cinecitta*

Participants: Marc Christie [marc.christie@irisa.fr], Cunka Sanokho.

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

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.

7.2. European Initiatives

7.2.1. FP7 STREP *Fet-Open Tango*

Participants: Julien Pettré [contact], Jonathan Perrinet, Anne-Hélène Olivier.

The goal of the TANGO project is to take some familiar ideas about affective communication one radical step further by developing a framework to represent and model the essential interactive nature of social communication based on non-verbal communication with facial and bodily expression. Indeed, many everyday actions take place in a social and affective context and presuppose that the agents share this context. But current motion synthesis techniques, e.g. in computer graphics, mainly focus on physical factors. The role of other factors, and specifically psychological variables, is not yet well understood.

In 2012, we focused on interactions between real and virtual humans based on Virtual Reality. During body-based interactions between real and virtual actors, we modulate the emotional expression of the virtual actor. We experimentally observe how the real human react to this modulation.

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. SIMS

Title: Toward realistic and efficient simulation of highly complex systems

Inria principal investigator: Julien Pettré

International Partner (Institution - Laboratory - Researcher):

University of North Carolina at Chapel Hill (United States) - GAMMA Research Group - Ming LIN

Duration: 2012 - 2014

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.

7.3.2. Inria International Partners

- Collaboration with Zhejiang University, State Key Lab CAD&CG, China. Lead by Franck Multon and Julien Pettré (France) and Qunsheng Peng and Weidong Geng (China), following the EA BIRD (ended in 2010). The collaboration mainly involves the co-supervision of a PhD student.
- Collaboration with Queen's University Belfast, UK. Lead by Benoit Bideau and Richard Kulpa (France) and Cathy Craig (UK).

7.4. International Research Visitors

7.4.1. Visits of International Scientists

7.4.1.1. Internships

Hui-Yin WU (from May 2012 until Jul 2012)

Subject: Structured story models for Interactive Storytelling

Institution: National Cheng Chi University (Taiwan)

Funding: Inria Internship

Alexandra COVACI (from Jan 2012 until Jul 2012)

Subject: VR accelerator for learning basketball throws

Institution: University of Brasov (Romania)

Funding: Romanian funding for PhD mobility

7.4.2. Visits to International Teams

- Julien Pettré, Explorateur vist, July 2012, Trinity College Dublin (1 month)
- Edouard Auvinet, joint PhD with University of Montreal, Canada (24 months in Canada on 36 months), Cifre funding
- David Wolinski, (Master student), 3 month visit to Chapel Hill, University of North Carolina, USA

SIROCCO Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR-PERSEE

Participants: Josselin Gautier, Christine Guillemot, Laurent Guillo, Olivier Le Meur, Fabien Racapé.

- Title : Perceptual coding for 2D and 3D images.
- Research axis : § 6.2.2 , 6.1.1 .
- Partners : IRCCYN-Polytech Nantes, INSA-Rennes, Telecom Paris Tech.
- Funding : ANR.
- Period : 10/2009-08/2013

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 relevant for mono-view and multi-view video coding: visual attention modeling (see Section 6.1.1), on 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 6.2.2 . 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.
- 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. A first approach using exemplar-based inpainting with neighbor embedding techniques has been developed. This method is currently being improved along three directions: 1/- the use of new distance metrics for finding the best matching patches; 2/- using a multi-resolution approach to both reduce the computational time and improve the robustness of the method; 3/- using mosaicking techniques for enhancing steps of stationary background and spatial inpainting. These solutions are studied in the context of a video compression and transmission chain using the emerging HEVC coding standard.

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 : Visiting professor from Beijing 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

Mattei Mancas, researcher from the Univ. of Mons, Belgium has visited the team for two months (June-July 2012).

Dr. Zhi Liu, from Beijing University, is 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).

TEXMEX Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR *Attelage de systèmes hétérogènes*

Participants: Guillaume Gravier, Bogdan Ludusan.

Duration: 3 years, started in November 2009.

Partners: IRISA, LIA, LIUM

The project ASH (Automatic System Harnessing – ANR-09-BLAN-0161-03) aims at developing new collaborative paradigms for speech recognition. Many current ASR systems rely on an a posteriori combination of the output of several systems (e.g., confusion network combination). In the ASH project, we investigate new approaches in which three ASR systems work in parallel, exchanging information at every step of the recognition process rather than limiting ourselves to an a posteriori combination. What information is to be shared and how to share such information and make use of it are the key questions that the project is addressing. The collaborative paradigm is being extended to landmark-based speech recognition where detection of landmarks and speech transcription can be considered as two (or more) collaborative processes.

8.1.2. ANR *FIRE-ID*

Participants: Sébastien Champion, 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.

8.1.3. ANR *Secular*

Participants: Laurent Amsaleg, Teddy Furon, Benjamin Mathon, Ewa Kijak.

Duration: 3 years, started in September 2012.

Partners: Morpho, Univ. Caen GREYC, Telecom ParisTech, Inria Rennes

Since their invention, content based image retrieval systems (CBRS) and biometric systems have evolved separately. This is due to the fact that they originate from different research and industrial communities. This Basic Research project, called *SecuLar*, groups researchers from both communities who have observed that both type of systems have indeed a lot in common in terms of goals and technological blocks. These techniques are used, however, in quite different settings possibly explaining the gap between the two. The people involved in this *SecuLar* project believe that what is specific to each family of approach can now benefit the other for the two following fundamental reasons.

Biometrics needs scale. The size of biometric databases quickly increases. It grows in terms of the number of records kept in the database. It also grows in terms of the size of each record as larger biometric templates maintain high quality recognition. The amount of data becomes large enough to require powerful indexing techniques. CBRS are good at this as they allow ultra fast searches of nearest neighbours in huge datasets. But porting these techniques to a biometric context is far from being easy. Biometric databases are typically protected to enforce confidentiality and privacy as security is paramount. Indexing biometric data is thus difficult because the techniques enforcing security in biometrics conflict with the technique bringing efficiency to database searches. No biometric system can today cope with both all the privacy and security constraints and the scale at which they should work in the real world for new applications.

CBRS need security and privacy. We witness a new use of CBRS these days. 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. Here, we plan to understand how biometrics related techniques can help increasing the security levels of CBIRS while not degrading their performance.

8.2. European Initiatives

8.2.1. *Quaero*

Participants: Laurent Amsaleg, Sébastien Campion, Vincent Claveau, Ali Reza Ebadat, Julien Fayolle, Patrick Gros, Gylfi Gudmundsson, Camille Guinaudeau, 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 2012, a key fact is our strong participation to Mediaeval to evaluate the technologies developed in Quaero.

8.3. International Initiatives

8.3.1. *Participation in International Programs*

Participants: Patrick Gros, Guillaume Gravier.

Duration: 2 years

Collaboration Inria-FAPEMIG with PUC Minas and UFMG – Brazil

The collaboration started this year with a visit of Patrick Gros to Belo Horizonte. The thesis of a brazilian student, Bruno Teixeira, will be co-advised, and he will spend 6 months in France next year. His work focuses on video high level description for video classification.

8.4. International Research Visitors

8.4.1. *Visits of International Scientists*

- **Visit of Fabio Guimaraes, 1 week in March 2012.** This visit was the opportunity to launch our collaboration with Brazil, which will take place in the framework of the Inria-FAPEMIG program. The main topic of the collaboration will be video multimodal description.
- **Visit of Michael Houle, National Institute of Informatics, Tokyo, Japan.** This visit was dedicated to share knowledge and initiate a collaboration for high-dimensional indexing.

8.4.2. *Internships*

- Michele Trevisiol

Dates: May 2012–July 2013 (3 months)

Subject: Geo-Tagging of Flickr videos, evaluated in the context of the Mediaeval's Placing task.

Institution: Yahoo Research & Universitat Pompeu Fabra (Barcelona)

- Giorgos Toliás

Dates: October 2012–January 2013 (5 months)

Subject: Large scale visual search

Institution: National Technical University of Athens (Greece)

VR4I Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. FUI SIFORAS

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

SIFORAS (Simulation for training and assistance), based on GVT 5.2 , aims to propose Instructional Systems Design to answer the new objectives of training (Intelligent Tutorial System, mobility, augmented reality, high productivity).

SIFORAS involves Academic partners 4 (INSA Rennes, ENIB, CEA-List, ENISE) and 9 Industrial partners (Nexter Training, Delta CAD, Virtualys, DAF Conseils, Nexter Systems, DCNS, Renault, SNCF, Alstom).

In this project, INSA Rennes-VR4i aims ensuring consistency with respect to CORVETTE project (see section 7.1.3) in particular for the global architecture based on STORM and LORA models.

7.1.2. ANR Collaviz

Participants: Thierry Duval [contact], Valérie Gouranton [contact], Cédric Fleury, Van Viet Pham.

Collaviz is an innovative multi-domain remote collaborative platform (project ANR-08-COSI-003-11 funded by the french national research agency) for the simulation-based design applications.

Collaviz was involving 6 Academic partners (ECP, EGID, INPT, INSA Rennes, LIRIS, Scilab) and 11 Industrial partners (Artenum, BRGM, Distene, EDF, Faurecia, Medit, MCLP Consulting, NECS, Oxalya, TechViz, Teratec). The Collaviz ended at on 30th June 2012.

The major value brought by Collaviz to the scientific and industrial community is to make remote analysis and collaboration easily available and scalable. Web-based technologies, on the top of shared high-performance computing and visualization centers, will permit researchers and engineers handling very large data sets, including 3D data models, by using a single workstation, wherever in the world. Just a "standard" internet connexion will be needed. The classical approach is not adapted anymore: simulation-based design applications tend to generate Terabytes and even Petabytes of data.

We were leading the WP4 about Collaborative Virtual Environments and Techniques, whose aim was to manage the 3D collaborative interactions of the users. During 2012 we contributed to the second Collaviz prototype by building upon it new collaborative interaction metaphors. We also improved the Collaviz software architecture in order to provide interoperability, making it possible to share a virtual universe between heterogeneous 3D viewers. We added a JMonkeyEngine viewer dedicated to deploy Collaviz on mobile devices such as tablets. We also made a link with the VCoRE project by adding a C++ OpenSG viewer to the our Java Collaviz framework.

We have also deployed the Collaviz framework between London (in the immersive room of the University College of London) and Rennes (in our Immersia room). We setup an experiment of collaborative manipulation of a clipping plane inside 3D scientific data within VISIONAIR project. This first real deployment of Collaviz was a success, it has allowed efficient co-manipulation of a shared 3D object between two really distant users, and the experimental results have been presented in [20]. Collaviz has then been deployed in the Inria Sophia-Antipolis immersive system in the context of the VCoRE project.

7.1.3. ANR Corvette

Participants: Bruno Arnaldi [contact], Valérie Gouranton [contact], Florian Nouviale, Andrés Saraos Luna.

Corvette (CollaboRative Virtual Environment Technical Training and Experiment) based on GVT 5.2, aims to propose a set of scientific innovations in industrial training domain (maintenance, complex procedures, security, diagnostic, ...) exploiting virtual reality technologies. This project has several scientific axes : collaborative work, virtual human, communication and evaluation.

Corvette involves 3 Academic partners (INSA Rennes, ENIB, CEA-List) and 4 Industrial partners (AFPA, Nexter Training, Virtualys, Golaem). We (INSA Rennes) are leading the ANR Corvette.

The project seeks to put in synergy a number of scientific axes:

- Collaborative work that can handle representative complex scenarios of industrial training
- Virtual Human for its ability to embody the user as an avatar and acting as a collaborator during training
- Natural communication between users and virtual humans for task-oriented dialogues
- Methodology in cognitive psychology for the assessment of the effectiveness of the collaboration of users and virtual humans to perform complex cooperative tasks in a virtual environment.

Unit contributions and technologies are demonstrated. Each partner has integrated global constraints of the project to produce the technical elements in relation to their contributions. The next step is to combine the components into a unified environment and have it validated by industrial use cases.

For further information: <http://corvette.irisa.fr/>

7.1.4. ANR Acoustic

Participant: Maud Marchal [contact].

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. VR4i is involved in the project with Shaman Inria project-team 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.

7.1.5. ANR Open-ViBE2

Participants: Laurent Bonnet, Laurent George, Anatole Lécuyer [contact], Jozef Legeny.

OpenViBE2 is a 3-year project funded by the French National Agency for Research. The objective of OpenViBE2 is to propose a radical shift of perspective about the use of Brain-Computer Interfaces (BCI). First, in OpenViBE2 we consider 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 is not seen as a replacement but as a complement of classical HCI. Second, we aim 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).

One major strength of OpenViBE2 consortium relies on the fact that four partners were already involved in the previous ANR project OpenViBE1 (2005-2009): Inria, INSERM, GIPSA-LAB, CEA. In addition, six partners have joined OpenViBE2 to bring their complementary expertise required by the scope of our proposal: CHART, CLARTE, UBISOFT, BLACK SHEEP, and KYLOTONN.

In parallel, the OpenViBE2 consortium contributes to the free and open-source software OpenViBE, which is devoted to the design, test and use of Brain-Computer Interfaces (see Section 5.3).

7.1.6. ANR HOMO TEXTILUS

Participants: Anatole Lécuyer [contact], Jozef Legeny, Maud Marchal, Jonathan Mercier.

HOMO TEXTILUS is a 3-year project funded by the French National Agency for Research (2012-2015). 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 VR4i team in the project consists in contributing to 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 (electroencephalography 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.

Partners of the project are : Inria, CHART, LIP6, TOMORROW LAND, RCP and potential end-user is Hussein Chalayan fashion creator.

7.1.7. ANR MANDARIN

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

MANDARIN is a 3-year project funded by the French National Agency for Research (2012-2015). The objective of MANDARIN is to study the design of truly dexterous haptic peripherals allowing natural and intuitive mono or bi-manual interactions with force feedback in virtual environments. The design of an innovative and comfortable and high performance force feedback glove is planned in the project, based on accurate biomechanical models of the human hand. The involvement of VR4i team in the project consists in contributing to the design of novel multimodal 3D interactions techniques and metaphors allowing to deal with haptic gloves limitations and to assist the user in virtual applications requiring dexterous manipulation. The scientific results will be evaluated with a representative industrial application proposed by Renault, that is not feasible currently with existing technologies (bi-manual manipulation of complex rigid objects and cables bundles).

Partners of the project are : Inria, CEA, UTC, Haption, Renault (potential end-user)

7.2. European Initiatives

7.2.1. INFRA-FP7: VISIONAIR

Participants: Georges Dumont [contact], Bruno Arnaldi, Valérie Gouranton, Thierry Duval, Alain Chauffaut, Ronan Gaugne.

Our actual Virtual Reality systems allowed us to be a key partner within the European Project VISIONAIR (<http://www.infra-visionair.eu/>) that began in February 2011 in the infrastructure call of FP7. Our Immersia (see section 6.4) Virtual Reality room is now, 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. The VISIONAIR 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 partners, INPG ENTREPRISE SA IESA France , Institut Polytechnique de Grenoble France, University of Patras LMS Greece, Cranfield University United Kingdom, Universiteit Twente Utwente Netherlands, Universitaet Stuttgart Germany, Instytut Chemii Bioorganicznej Pan Pscn Poland, Université De La Méditerranée D'aix-Marseille II France, Consiglio Nazionale Delle Ricerche CNR Italy, Institut National de Recherche en Informatique et en Automatique Inria France, Kungliga Tekniska Hoegskolan Sweden, Technion - Israel Institute of Technology Israel, Rheinisch-Westfaelische Technische Hochschule Aachen RWTH Germany, Poznan University of Technology Poland, Arts et Métiers ParisTech AMPT France, Technische Universitaet Kaiserslautern Germany, The University of Salford United Kingdom, Fraunhofer-gesellschaft zur foerderung der Angewandten Forschung Germany, fundacio privada I2CAT Spain, University of Essex United Kingdom, Magyar Tudomanyos Akademia Szamitastechnikai Es Automatizalasi Kutato Intezet Hungary, École Centrale de Nantes France, University College of London United Kingdom, Politecnico di Milano Polimi Italy, European Manufacturing and Innovation Research Association (cluster leading excellence).

7.2.2. **STREP: NIW**

Participants: Gabriel Cirio, Anatole Lécuyer [contact], Maud Marchal, Léo Terziman.

The Natural Interactive Walking Project (NIW) is a 3-year project funded by the European Commission under the FET Open STREP call. NIW involves 5 partners: Inria/VR4i (Bunraku), University of Verona (leader), University of Aalborg, University of Paris 6, and McGill University. The Natural Interactive Walking (NIW) project aims at taking advantage of multisensory information about the ground to develop knowledge for designing walking experiences. This will be accomplished through the engineering and perceptual validation of human-computer interfaces conveying virtual cues of everyday ground attributes and events. Such cues may be conveyed by auditory, haptic, pseudo-haptic, and visual augmentation of otherwise neutral grounds. The project is focused on creating efficient and scalable display methods across these modalities that can be easily and cost-effectively reproduced, via augmented floors and footwear.

It is expected that the NIW project will contribute to scientific knowledge in two key areas. First, it will reinforce the understanding of how our feet interact with surfaces on which we walk. Second, it will inform the design of such interactions, by forging links with recent advances in the haptics of direct manipulation and in locomotion in real-world environments. The methods that will be created could impact a wide range of future applications that have become prominent in recently funded research within Europe and North America. Examples include floor-based navigational aids for airports or railway stations, guidance systems for the visually impaired, augmented reality training systems for search and rescue, interactive entertainment, and physical rehabilitation.

More information can be found on Natural Interactive Walking project website : <http://www.niwproject.eu/>

7.2.3. **BRAINVOX**

Participants: Anatole Lécuyer [contact], Jozef Legeny [contact].

The BRAINVOX project is a project funded by Brittany region in the frame of the CREATE call. It is a 4 year-project (2008-2012), on the topic of Brain-Computer Interfaces.

The "blue-sky" vision of the BrainVox project is a "mental language", more elaborated, and richer, for BCI applications. We want to study the possibility for a single user to exploit various mental activities, in order to achieve more varied operations in the BCI-based application within novel hybrid BCI schemes. In the end, this novel mental language would enable a practice of BCI richer and more intuitive, with more potential actions in the real world. This should improve the spreading of BCI technologies in numerous applications such as multimedia and video games, but also assistance to disabled people.

7.2.4. **ADT-Mixed Reality Technological Development: VCore**

Participants: Georges Dumont [contact], Thierry Duval, Valérie Gouranton, Alain Chauffaut [contact], Ronan Gaugne [contact], Rémi Félix.

The Mixed Reality Project is a shared collaboration between Fraunhofer IGD and five Inria research centers: Rennes, Grenoble, Sophia, Lille and Saclay. On the Inria side, the project started in October 2011, with a four-year outlook, as an ADT with two IJDs, one in Rennes and one in Sophia. The goal of the project is to build a modular shared source software framework, fostering the development of new and unique research topics and application areas, which can be used alike by research teams and innovative companies. The goal is to make it a de facto standard, favoring interoperability between various developments in the mixed reality area. Research teams will get a sound software base that helps them focus their efforts on innovative software libraries or applications. Companies will benefit from implementations of state-of-the-art algorithms as well as a full-fledged framework strongly connected with 3D-related emerging standards like Collada, X3D and WebGL.