Activity Report 2013

Section Partnerships and Cooperations

ALGORITHMICS, PROGRAMMING, SOFTWARE AND ARCHITECTURE

APPLIED MATHEMATICS, COMPUTATION AND SIMULATION

COMPUTATIONAL SCIENCES FOR BIOLOGY, MEDICINE AND THE ENVIRONMENT

DIGITAL HEALTH, BIOLOGY AND EARTH

NETWORKS, SYSTEMS AND SERVICES, DISTRIBUTED COMPUTING

PERCEPTION, COGNITION AND INTERACTION

CAMUS Team

8. Partnerships and Cooperations

8.1. National Initiatives

Philippe Clauss, Alain Ketterlin, Cédric Bastoul and Vincent Loechner are involved in the Inria Large Scale Initiative entitled "Large scale multicore virtualization for performance scaling and portability" and regrouping several french researchers in compilers, parallel computing and program optimization. The project started officially in January 2013. In this context and since January 2013, Philippe Clauss is co-advising with Erven Rohou of the Inria team ALF, Nabil Hallou's PhD thesis focusing on dynamic optimization of binary code.

The CAMUS team is taking part of the NANO 2017 national research program with the company STMicroelectronics, starting January 2014.

8.2. European Initiatives

8.2.1. *Collaborations in European Programs, except FP7*

Program: ITEA

Project acronym: MANY

Project title: Many-core Programming and Resource Management for High-Performance Embedded Systems

Duration: 09/2011 - 08/2014

Coordinator: XDIN

Other partners: France: Thales Communications and Security, CAPS Entreprise, Telecom SudParis; Spain: UAB; Sweden: XDIN; Korea: ETRI, TestMidas, SevenCore; Netherlands: Vector Fabrics, ST-Ericsson, TU Eindhoven; Belgium: UMONS.

Abstract: Adapting Industry for the for the disruptive landing of many-core processors in Embedded Systems in order to provide scalable, reusable and very fast sofware development.

8.3. International Initiatives

8.3.1. *Inria Associate Teams*

8.3.1.1. *ANCOME*

Title: Memory and applications memory behavior

Inria principal investigator: Philippe Clauss

International Partner (Institution - Laboratory - Researcher):

> University of Buenos Aires (Argentina) - Departamento de Computación, Facultad de Ciencias Exactas y Naturales - Philippe Clauss

Duration: 2011 - 2013

See also: http://lafhis.dc.uba.ar/wiki/index.php/EA-Ancome

This associate team focuses on developing original methods for the analysis of programs memory behavior, in particular in the context of applications using dynamic memory allocation. The proposed approaches consist in analyzing and modeling the runtime behavior, where extracted properties are then verified thanks to static analysis processes. Thus pure static approaches limits will be overpassed. Further, the case of multi-threaded applications run on multi-core architectures will be studied in order to elaborate and extend our analysis techniques and to extract properties specific to this context. The issues are mainly concerned with the conception of real-time applications using dynamic memory allocation.

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

The CAMUS team maintains regular contacts with the following entities:

- Reservoir Labs, New York, NY, USA
- Intel, Santa Clara, CA, USA
- UPMARC, University of Uppsala, Sweden
- University of Batna, Algeria
- University El Manar, Tunis, Tunisia
- Ohio State University, Colombus, USA
- Louisiana State University, Baton Rouge, USA
- Indian Institute of Science (IIIS) Bangalore, India
- University of Delaware, DE, USA

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Diego Garbervetsky, University of Buenos Aires, Argentina, has made three visits in the CAMUS team at the following dates: Dec. 1-14, Oct. 14-20 and Jan. 15-23.

Rachid Seghir, University of Batna, Algeria, visited the team from May the 30th to June the 13th.

8.4.1.1. Internships

Javier Corti

Subject: Certified Compiler for polyhedral transformations

Date: from Mar 2013 until Aug 2013

Institution: Universidad National de Rosario (Argentina)

Imen Fassi

Subject: Multifor for Multicore

Date: from Mar 2013 until Aug 2013

Institution: Université de Tunis El Manar - Faculté des Sciences (Tunisia)

Dhruva Tirumala Bukkapatnam

Subject: Evaluation of the Kalray MPPA and extension of the Pluto compiler

Date: from Apr 2013 until Oct 2013

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

8.4.2. Visits to International Teams

Philippe Clauss has spent one week in the LAFHIS team, University of Buenos Aires, Argentina, in October 2013.

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. *Function field sieve: implementation and hardware acceleration*

Participants: Jérémie Detrey [contact], Pierrick Gaudry, Hamza Jeljeli, Emmanuel Thomé.

The team has obtained for the years 2012 and 2013 a financial support from the Région Lorraine and Inria for a project focusing on the hardware implementation and acceleration of the function field sieve (FFS).

The FFS algorithm is currently the best known method to compute discrete logarithms in small-characteristic finite fields, such as may occur in pairing-based cryptosystems. Its study is therefore crucial to accurately assess the key-lengths which such cryptosystems should use. More precisely, this project aims at quantifying how much this algorithm can benefit from recent hardware technologies such as GPUs or CPU-embedded FPGAs, and how this might impact current key length recommendations.

While the more FPGA-related aspects of this project were put on hold in 2013, the GPU option was explored further. To this end, eight NVIDIA GeForce GTX 680 graphics cards were bought and installed in four nodes connected by an InfiniBand. Hamza Jeljeli was able to extend his GPU implementation of sparse linear algebra routines so as to take multi-GPU and multi-node computations into account. This setup was for instance used to break the discrete-logarithm record over an 809-bit binary field [15].

8.2. National Initiatives

The team participates in the "Calcul formel, arithmétique, protection de l'information" research pole of the GDR-IM (CNRS Research Groupon Mathematical Computer Science). The team is a member of the "Arithmétique", "Calcul formel" and "Codage et Cryptographie" working groups.

8.2.1. *ANR CATREL (Cribles: Améliorations Théoriques et Résolution Effective du Logarithme discret)*

Participants: Razvan Barbulescu, Cyril Bouvier, Jérémie Detrey, Pierrick Gaudry, Hamza Jeljeli, Emmanuel Thomé [contact], Marion Videau, Paul Zimmermann.

The CATREL proposal has been accepted in ANR "programme Blanc" in 2012. This project involves CARAMEL as a leading team, in cooperation with two other partners which are Inria project-team GRACE (Inria Saclay, LIX, École polytechnique), and the Arith team of the LIRMM Laboratory (Montpellier). The project targets the algorithms for solving the discrete logarithm problem in finite fields, using the Number Field Sieve and the Function Field Sieve algorithms. Actual work on the CATREL project started in January 2013. Three meetings have taken place already: in Nancy on Dec. 14th, 2012 (kick-off), in Palaiseau on June 19, 2013, and in Monpellier on November 12-13, 2013.

8.2.2. *GDR-IM supported travel for PhD students*

Hamza Jeljeli collaborated with Bastien Vialla from LIRMM, Montpellier to integrate RNS-based code in $\text{mp}\mathbb{F}_q$ and CADO-NFS. This collaboration was funded by the GDR-IM program "visite de doctorants".

8.3. International Research Visitors

8.3.1. *Visits of International Scientists*

Shi Bai from the univeristy of Auckland, NZ, visited us in June 2013.

Thorsten Kleinjung, from the EPFL, visited us in October 2013.

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

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- The team was a funding parter in ANR Complice (Implicit Computational Complexity, Concurrency and Extraction), ref.: ANR-08-BLANC-0211-01, that ended in april 2013 and whose aim was to extend the results of ICC to other paradigms (process languages, ...) and take benefice of proof extraction techniques in order to synthesize resoure certificates. This ANR should be followed by a new ANR submission (ANR Elica proposal) involving Paris 7 PPS team, Paris 13 LCC team, ENS Lyon Plume team and Bologna Inria team Focus.

- The team is a funding parter in ANR Binsec, whose aim is to fill part of the gap between formal methods over executable code on one side, and binary-level security analyses currently used in the security industry. Two main applicative domains are targeted: vulnerability analysis and virus detection. Two other closely related applications will also be investigated: crash analysis and program deobfuscation.

- Emmanuel Jeandel is a member of ANR Blanche ANR-09-BLAN-0164 (EMC: *Emerging Phenomena in Computation Models*), that ended in April 2013.

8.1.2. PEPS

- Simon Perdrix is a member of a PEPS INS2I "Information et Communication Quantique: Cryptographie et Calcul Quantiques Distribués." with partners in Telecom ParisTech and other labs.

- Mathieu Hoyrup is principal investigator of a PEPS INS2I "Approches Topologiques de l'Information et de la Calculabilité", with Emmanuel Jeandel and Laurent Bienvenu (CNRS, LIAFA).

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. FI-WARE

Title: Morphus

Type: COOPERATION

Defi: PPP FI: Technology Foundation: Future Internet Core Platform

Instrument: Integrated Project (IP)

Objectif: PPP FI: Technology Foundation:Future Internet Core Platform

Duration: September 2011 - May 2014

Coordinator: Telefonica (Spain)

Other Partners: Thales, SAP, Inria

Inria contact: Olivier Festor

Abstract: See also: http://www.fi-ware.eu/. FI-WARE will deliver a novel service infrastructure, building upon elements (called Generic Enablers) which offer reusable and commonly shared functions making it easier to develop Future Internet Applications in multiple sectors. This infrastructure will bring significant and quantifiable improvements in the performance, reliability and production costs linked to Internet Applications for building a true foundation for the Future Internet.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

The team has an informal partnership with Pr. James Royer (University of Syracuse) and PhD. Norman Danner (Wesleyan University) on the study of program higher order complexity (an Inria associated team proposal has been submitted on this domain). On the Implicit Computational Complexity part, the team has strong contacts with Universita di Torino (Pr Simona Ronchi Della Rocca), Dundee University(PhD Marco Gaboardi), Universita di Bologna (Pr Simone Martini and PhD Ugo Dal Lago).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Subramanian Kumbakonam Govindarajan, professor in Universiti Sains Malaysia, was visiting Carte team in february. He works on computational models and Parikh matrices.

Neil Jones, professor in the University of Copenhagen, visited Carte team for one month in March. He is currently working on program transformation and program obfuscation, which have obvious applications to Computer Virology.

8.4.2. Visits to International Teams

Mathieu Hoyrup visited Universidad Andres Bello in Santiago de Chile during february. He worked there with Cristobal Rojas on extending the results [22] from functions to relations.

CASSIS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- Franche-Comté Region project SyVAD (SysML Verification and Validation), coordinated by Fabrice Bouquet, duration: 3 years, started in September 2011. This project focuses on the SysML models for the validation and verification of the micro-systems, in particular for distributed micro airduct. The project associates several team of FEMTO-ST institute.

8.2. National Initiatives

8.2.1. ANR

- ANR PROSE *Protocoles de sécurité : modèle formel, modèle calculatoire, and implémentations — Security protocols : formal model, computational model, and implementations*, duration: 4 years, started in December 2010. The goal of the project is to increase the confidence in security protocols, and in order to reach this goal, provide security proofs at three levels: *(i)* the symbolic level, in which messages are terms, *(ii)* the computational level, in which messages are bitstrings, and *(iii)* the implementation level: the program itself. Partners are EPI Prosecco and EPI Cascade Paris (leader), LSV Cachan, Cassis and Verimag Grenoble.

- ANR STREAMS *Solution for Peer-to-peer Real-Time Social Web*, duration: 3 years, starting in October 2010. This project proposes to design peer-to-peer solutions that offer underlying services required by real-time social web applications and that eliminate the disadvantages of centralised architectures. There exists a tension between sharing data with friends in a social network deployed in an open peer-to-peer network and ensuring privacy. One of the most challenging issues in social applications is how to balance collaboration with access control to shared objects. This project aims at providing theoretical solutions to these challenges as well as practical experimentations. Partners are: LORIA Score team (leader), Inria project-teams Regal, Asap, Cassis, and XWiki.

- ANR FREC *Frontiers of recognizability*, duration: 4 years, starting in October 2010. The goal of this project is to be a driving force behind the extension of the algebraic theory of regular languages made possible by recent advances. Four directions will be investigated: tree languages, λ-terms, automata with counters, algebraic and topological tools. Partners are LABRI (leader), LIAFA (University Paris 7). Pierre-Cyrille Héam is a member of this project, attached to Paris 7 for administrative facilities.

- ANR OSEP *Online and offline model-based testing of SEcurity Properties*, duration: 2 years, started in November 2011 and ended in November 2013. The goal of this project was to apply online and offline model-based testing approaches for security testing of cryptographic components and software radio case studies, used as a black boxes. This approach had to be compatible with our previous offline approaches to increase the number of artefacts that can be shared. So, we developed new algorithms to allow online testing, and a dedicated tool called MBeeTle. This project was an opportunity to reuse the results of the ANR TASCCC project, and to complete these approaches with security properties expressed in TOCL. This project involved the DGA and Smartesting.

8.2.2. Competitivity Clusters

- FUI SQUASH *Software QUality ASsurance enHancement*, duration: 2 years, starting in April 2011. This project aims to industrialize and to structure software testing activities. The project will provide a methodology and tools based on open source components.

- Project "Investissement d'Avenir - Développement de l'Econimie Numérique" DAST (Dynamic Application Security Testing), duration: 2 years, starting in September 2012. The goal of this project is to generate automatically the tests to prevent vulnerabilities. We have proposed an automated model-based vulnerability testing approach, that focuses on Criss-Site Scripting vulnerabilities in web applications. It relies on a behavioral model that describes the web application and a set of security test patterns formalizing ways to detect the vulnerabilities. This partnership includes NBSystem, Smartesting (coordinator), Thales, Trusted-Labs and Inria CASSIS.

8.3. European Initiatives

8.3.1. FP7 Projects

- Nessos is a Network of Excellence on Engineering Secure Future Internet Software Services and Systems in FP7-ICT (starting in October 2010 for a period of 42 months). Nessos has 12 partners and aims at constituting and integrating a long lasting research community on engineering secure software-based services and systems. Partner Inria is involved through project-teams Arles, Triskell and Cassis. Cassis will focus on developping tools for service security verification and testing tasks.

- ProSecure (2011-2016) [9]— ERC Starting Grant Project on Provably secure systems: foundations, design, and modularity. This long-term project aims at developing provably secure systems such as security protocols. The goal is to propose foundations for a careful analysis and design of large classes of up-to-date protocols. To achieve this goal, we foresee three main tasks. First, we plan to develop general verification techniques for new classes of protocols that are of primary interest in nowadays life like e-voting protocols, routing protocols or security APIs. Second, we will consider the cryptographic part of the primitives that are used in such protocols (encryption, signatures, ...), obtaining higher security guarantees. Third, we aim at proposing modular results both for the analysis and design of protocols. Véronique Cortier is the leader of the project.

8.4. International Initiatives

8.4.1. Inria Associate Teams

BANANAS [10]*Automated design and autonomous control of hybrid solver cooperations*. In order to tackle large scale instances and intricate problem structures, sophisticated solving techniques have been developed, combined, and hybridized to provide efficient solvers. A common idea to get more efficient and robust algorithms consists in combining several resolution paradigms in order to take advantage of their respective assets. Autonomous Search is a very attractive approach for designing adaptive systems with the capability of improving its solving performance by selecting and adapting its search strategies to the problem at hand. The main goal of the project is to apply the Autonomous Search approach to hybrid solver cooperations, by automating the selection and the cooperation of solvers, by tuning the cooperation parameters, and by adapting the cooperation during solving. The international partners are Technical University Federico Santa Maria, Valparaíso (Chile) — Department of Computer Science — Carlos Castro and Eric Monfroy; University of Chile (Chile) — Center for Mathematical Modeling — Jorge Amaya. The Inria principal investigator is Christophe Ringeissen.

8.4.2. Inria International Partners

- Collaboration with Bogdan Warinschi (Bristol University) on soundness of symbolic models w.r.t. cryptographic ones.

- Collaboration with Mark Ryan's group (University of Birmingham) on the formal analysis of e-voting protocols.

- Collaboration with Paliath Narendran's group (SUNY Albany) on automated deduction.

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[9]http://www.loria.fr/~cortier/ProSecure.html
[10]http://www.loria.fr/~ringeiss/CHILI/bananas

- Collaboration with Hanifa Boucheneb's group (Ecole Polytechnique de Montréal) on model-checking of collaborative systems.
- Collaboration with John Mullins's group (Ecole Polytechnique de Montréal) on information hiding.

8.4.3. Participation in International Programs

French-Tunisian project on *Security Policies and Configurations of Firewalls: Compilation and Automated Verification*. We collaborate with SupCom Tunis and the Inria project-team Dahu in the context of STIC-Tunisia.

French-Canadian project on *Automata for Hiding and Disclosing Information*, in the framework of the CFQCU program. We collaborate with the CRAC team at the Ecole Polytechnique de Montréal, Canada, and the MoVe team/LIP6 at the UPMC, Paris, France.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Myrto Arapinis (University of Edinburgh), one week in January 2013, two weeks in November 2013
- Florian Boehl (KIT University), one week in January 2013
- Luigi Grillo (Università di Catania), two weeks in April 2013
- Dominique Unruh (Tallin University), one week in February 2013
- Bogdan Warinschi (University of Bristol), one week in January 2013
- Paliath Narendran (SUNY Albany), one month in June-July 2013
- David Bouchard and Kim Gero (SUNY Albany), one week in September 2013
- Christoph Sprenger and Binh Nguyen (ETH Zürich) three days in April 2013

8.5.1.1. Internships

We have supervised the following internships.

Anisia Maria Magdalena Tudorescu

Subject: Integrating SMT solvers into Spike

Supervisors: Pascal Fontaine (project-team Veridis), Sorin Stratulat, and Christophe Ringeissen

Date: from Mar 2013 until May 2013

Institution: West Timisoara University (Romania)

Gisela-Carla Rossi

Subject: Formal Methods for Secure Service Composition

Supervisors: Walid Belkhir and Michaël Rusinowitch

Date: from Jun 2013 until Dec 2013

Institution: National University of Cordoba (Argentina)

Paula Chocrón

Subject: Non-disjoint combination for SMT solvers: sharing a fragment of arithmetic

Supervisors: Pascal Fontaine (project-team Veridis) and Christophe Ringeissen

Date: from Sep 2013 until Nov 2013

Institution: University of Buenos Aires (Argentina)

Gemma Puig-Quer

Subject: New protocols for private e-voting

Supervisors: David Galindo-Chacon and Véronique Cortier

Date: from Sep 2013 until Mar 2014

Institution: UPC Barcelona (Spain)

In addition, Steve Kremer has supervised the following students from the École des Mines de Nancy:

- Othmane El Omri, Analysis of a peer-to-peer E-wallet protocol (from Jul 2013 to Sep 2013)
- Pierre Lepeudry, Formalizing some combinatorial attacks in security protocols (from Sep 2013 to Jan 2014)

and Véronique Cortier and Cyrille Wiedling have supervised a group of three students from the École des Mines de Nancy on the implementation of a secure key management system on smartcards: Arnaud Kéranguéven, Hadrien Chastant, and Othmane El Omri (from Oct 2012 to June 2013).

8.5.2. Visits to International Teams

- Olga Kouchnarenko, August 2013 (10 days), Ecole Polytechnique de Montréal (the CRAC team), Canada, visit funded by the Conseil franco-québécois de coopération universitaire" (CFQCU).

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

7. Partnerships and Cooperations

7.1. Regional Initiatives

We participate at the LORIA project entitled "Combining deduction engines into SMT".

7.2. National Initiatives

We participate in the "Logic and Complexity" part of the GDR–IM (CNRS Research Group on Mathematical Computer Science), in the projects "Logic, Algebra and Computation" (mixing algebraic and logical systems) and "Geometry of Computation" (using geometrical and topological methods in computer science).

7.3. International Research Visitors

7.3.1. Internships

Anisia Maria Magdalena Tudorescu

Subject: Integrating SMT solvers into Spike

Date: from Mar 2013 until May 2013

Institution: West Timisoara University (Romania)

Cosay Gurkay Topaktas

Subject: Property Based Testing

Date: from Feb 2013 until Jun 2013

Institution: Erasmus Mundus MSc in Dependable Software Systems

Fellype Vedovato Martins

Subject: Generation of Terms

Date: from Jun 2013 until Sept 2013

Institution: Mines-Nancy, 2nd year student

TRIO Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. BGLE DEPARTS

Participants: Liliana Cucu-Grosjean, Adriana Gogonel, Codé Lo, Cristian Maxim.

The project DEPARTS started on October 1st, 2012, but for administrative reasons the kick-off meeting was only on April, 2013. This project is funded by the national funding program BGLE. TRIO team proposes solutions for probabilistic component-based models and a PhD thesis will start early 2014. Such solution allows designers to unify in the same framework probabilistic scheduling techniques and compositional guarantees that have different levels of criticality. The schedulability analysis presented in [12], [6] are the bases of our future contributions.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. PROARTIS

> Type: COOPERATION
> Defi: Embedded Systems Design
> Instrument: Specific Targeted Research Project
> Objectif: Embedded Systems Design
> Duration: February 2010 - July 2013
> Coordinator: Barcelona Supercomputing Center (Spain)
> Inria contact: L. Cucu-Grosjean

Participants: Liliana Cucu-Grosjean, Adriana Gogonel, Codé Lo, Dorin Maxim and Cristian Maxim.

TRIO team participates to PROARTIS which is a STREP project within the FP7 call and it started on February 2010. It has six partners: Barcelona Supercomputing, University of York, University of Padova, Inria and Airbus. The overarching objective of the PROARTIS project is to facilitate a probabilistic approach to timing analysis. The PROARTIS approach concentrates on proving that pathological timing cases can only arise with negligible probability, instead of struggling to eradicate them, which is arguably not possible and could severely degrade performance. This is a major turn from previous approaches that seek analyzability by predicting with cycle accuracy the state of hardware and software through analysis.

The PROARTIS project facilitates the production of analysable CRTE systems on advanced hardware platforms with features such as memory hierarchies and multi core processors.

This project ended July 2013.

7.2.1.2. PROXIMA

> Type: COOPERATION
> Defi: Mixed-Criticality Systems
> Instrument: Integrated Project
> Objectif: Development of probabilistic approaches for mixed-criticality systems on multi-core and many-core platforms
> Duration: October 2013 - September 2016
> Coordinator: Barcelona Supercomputing Center (Spain)
> Inria contact: Liliana Cucu-Grosjean

Participants: Liliana Cucu-Grosjean, Adriana Gogonel, Codé Lo, Dorin Maxim and Cristian Maxim.

PROXIMA project started on October 1st, 2013 with a kick-off meeting in November 2013.

The PROXIMA hypothesis is that probabilistic analysis techniques can provide efficient (tractable) and effective (tight) analysis of the temporal behaviour of complex mixed-criticality applications on novel multicore and manycore platforms. Solid research results from the FP7 STREP PROARTIS project underpin this claim. The concept is based on using probabilistic analysis techniques to derive safe and tight bounds on the temporal behaviour of applications, reflecting requirements on failure rates commensurate with their criticality. PROXIMA defines architectural paradigms that break the causal dependence in the timing behaviour of execution components at hardware and software level that can give rise to pathological cases, and reduces that risk to quantifiable small levels. Only modest changes will be needed to this end in the hardware and software components beneath the application (processing cores, interconnects, memory hierarchies and controllers, real-time operating system, middleware, compilers).

7.2.2. *Collaborations in European Programs, except FP7*

7.2.2.1. European Network of Excellence (NOE) High Performance Embedded Architectures and Compilation (HiPEAC)
Participant: Olivier Zendra.

The TRIO team is involved in the HiPEAC 3 (High Performance Embedded Architecture and Compilation) European Network of Excellence (NoE). Olivier Zendra was initiator and leader in this context of a cluster of European Researchers "Architecture-aware compiler solutions for energy issues in embedded systems" from mid-2007 to mid-2009. A STREP proposal tentatively titled "RuSH2LEAP: Runtime Software-Hardware interactions to Lower Energy And Power" was written at the beginning of 2013, mostly in the context of this network of excellence, for submission in Call ICT 2013.10, challenge 3.4 Advanced computing, embedded and control systems. The proposal passed all thresholds, but failed to be funded.

7.3. International Research Visitors

7.3.1. *Visits of International Scientists*

Rob Davis (University of York) has continued to visit TRIO within the UK Seedcorn Grant that covers his visits in Nancy. This collaboration allowed to successfully apply for a FP7 IP project as well as an Inria International Chair that will start in 2014 within AOSTE (team that Liliana Cucu-Grosjean, Adriana Gogonel, Codé Lo and Cristian Maxim had joined before the end of 2013).

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

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. *ANR PRESAGE*

The white ANR grant PRESAGE brings together computational geometers (from the VEGAS and GEOMET-RICA projects of Inria) and probabilistic geometers (from Universities of Rouen, Orléans and Poitiers) to tackle new probabilistic geometry problems arising from the design and analysis of geometric algorithms and data structures. We focus on properties of discrete structures induced by or underlying random continuous geometric objects.

This is a four year project, with a total budget of 400kE, that started on Dec. 31st, 2011. It is coordinated by Xavier Goaoc (VEGAS).

6.1.2. *ANR SingCAST*

The objective of the young-researcher ANR grant SingCAST is to intertwine further symbolic/numeric approaches to compute efficiently solution sets of polynomial systems with topological and geometrical guarantees in singular cases. We focus on two applications: the visualization of algebraic curves and surfaces and the mechanical design of robots.

After identifying classes of problems with restricted types of singularities, we plan to develop dedicated symbolic-numerical methods that take advantage of the structure of the associated polynomial systems that cannot be handled by purely symbolical or numerical methods. Thus we plan to extend the class of manipulators that can be analyzed, and the class of algebraic curves and surfaces that can be visualized with certification.

This is a 3.5 years project, with a total budget of 100kE, that will start on March 1st 2014, coordinated by Guillaume Moroz.

6.2. International Research Visitors

Nuno Gonçalves, University of Coimbra (Portugal), visited the VEGAS project for 1 week in January.

William J. Lenhart, Williams College (USA), visited the VEGAS project for 2 weeks in May..

6.2.1. *Internships*

Ioannis Psarros

Subject: Common tangents to ellipsoids in $\mathbb{R}^3$.

Date: from Apr. 2013 until July 2013.

Institution: University of Athens, Greece.

Oswald Hounkounou

Subject: Study with computer algebra system of a conjecture relating the width of a convex polygon with the width of its inscribed triangles.

Date: from Apr. 2013 until Aug. 2013.

Institution: Telecom Nancy de l'université de Lorraine.

Judit Recknagel

Subject: Topology of planar singular curves resultant of two trivariate polynomials.

Date: from Apr. 2013 until Aug. 2013

Institution: Halle-Wittenberg university, Germany.

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

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Inria Development Action VeriT

Participants: Pablo Dobal, Pascal Fontaine.

Inria funds this project (started in 2011) to support the development of the SMT solver veriT (see section 5.1), including added expressiveness, improved efficiency and code stability, and interfaces with tools that embed veriT as a backend solver. The project is coordinated by Pascal Fontaine and also includes Inria Rennes (Celtique) and Sophia Antipolis (Marelle). Federico Dobal has been hired in 2012 on a position funded by this project and has in particular contributed to improvements in the code of the solver as well as of the testing platform that allows us to detect bugs and the impact of changes on the performance of the tool. He has also contributed to the maintenance of the deltaSMT tool, which has been used by several other teams of SMT developers for debugging SMT solvers.

8.2. European Initiatives

8.2.1. FP7 project MEALS

Type: PEOPLE

Instrument: International Research Staff Exchange Scheme

Objective: Exchange of scientists between Europe and Argentina

Duration: October 2011 - September 2015

Coordinator: Holger Hermanns, Universität des Saarlandes (Germany)

Partner: Universidad de Buenos Aires, Universidad Nacional de Córdoba, Universidad Nacional de Rio Cuarto, Instituto Tecnológico Buenos Aires

Inria contact: Castuscia Palamidessi

Abstract: The MEALS project funds exchanges between scientists in Europe (Saarland University, RWTH Aachen, TU Dresden, Inria, Imperial College, Univ. of Leicester, TU Eindhoven); it is structured in five work packages (Quantitative Analysis of Concurrent Program Behaviour, Reasoning Tasks for Specification and Verification, Security and Information Flow Properties, Synthesis in Model-based Systems Engineering, Foundations for the Elaboration and Analysis of Requirements Specifications). Our team mainly cooperates with the group led by Carlos Areces in Córdoba, as well with Diego Garbervetsky in Buenos Aires, within work package 2. In 2013, the project funded visits by Luciana Benotti, Rodrigo Castaño, Raúl Fervari, and Guillaume Hoffmann.

8.2.2. Cooperation with TU Wien, Austria

Participants: Pascal Fontaine, Stephan Merz.

This project – from January 2012 to December 2013 – fosters bilateral cooperation with the team headed by Prof. Alexander Leitsch at TU Vienna. It focuses on aspects of proof production and proof compression in automated reasoning. It is headed by Bruno Woltzenlogel Paleo of TU Wien, who was formerly a post-doctoral researcher in VeriDis until March 2011, and Pascal Fontaine. The project is funded by the Amadeus Programme of the Partenariat Hubert Curien and the Österreichischer Austausch Dienst.

The project funded the traveling costs for the participants for four one-week workshops in Vienna and Nancy. In particular, the third workshop was affiliated to Tableaux 2013 and was open to the participants of Tableaux; it attracted around 40 participants. The final workshop of the project took place in November 2013 in Vienna.

The discussions involved many aspects on proofs and allowed to improve some aspects of proof production in SMT, as well as several proof handling tools (e.g. Skeptik), developed among others at TU Wien. The web page gives more information on this project.

8.2.3. Cooperation with NUI Maynooth, Ireland

Participant: Dominique Méry.

The project *Building Reliable Systems: Software Refinement meets Software Verification* is a one-year project funded by PHC Ulysses. The academic Irish partner is Dr Rosemary Monahan of NUI Maynooth. The verification of software requires the specification of preconditions and postconditions as well as other properties of the code. These properties are expressed as annotations providing a detailed understanding of how the software is implemented. In program verification, the annotation process is often done *a posteriori*, with verification tools used to check that annotations are sound according to the semantics of the program. Determining the correct annotations to provide a complete specification is difficult, especially when specifying invariant properties of the code. *A priori* techniques for developing correct software are based on the correct-by-construction paradigm. The refinement-based approach is such a technique, providing for the construction of a correct program through the step-by-step refinement of an initial high-level model of the software. In this way, the program specification is developed alongside the code, discharging the conditions that need to be proved. We focus on combining these two software engineering techniques, to benefit from the strengths of both. We have proposed a framework [18] for integrating a representation of the *a posteriori* paradigm, namely Spec#, and a representation of the *a priori* paradigm, namely Event B. This integration induces a methodology which bridges the gap between software modeling and program verification in the software development life cycle.

8.3. International Initiatives

8.3.1. Participation In International Programs

8.3.1.1. Cooperation with Universidade Federal do Rio Grande de Norte, Brazil
Participants: David Déharbe, Pablo Dobal, Pascal Fontaine, Stephan Merz.

VeriDis has a close working relationship with a team at Universidade Federal do Rio Grande de Norte (UFRN), Brazil, and more specifically with Prof. David Déharbe. Pascal Fontaine visited Natal in early 2013. The project is centered around the development and applications of the veriT solver (section 5.1), of which David Déharbe and Pascal Fontaine are the main developers. Our cooperation was also supported by the Inria-CNPq project SMT-SAVeS from 2010 throughout early 2013.

A new STIC AmSud project has been approved that will start in 2014 and involves a team at the University of Córboba in Argentina, the team at UFRN, and VeriDis. It is again centered on SMT, with a particular focus on quantifiers and modal logic [21].

8.4. International Research Visitors

8.4.1. Visits of International Scientists

David Déharbe from UFRN (Natal, Brazil) joined the VeriDis team in Nancy for a one-year sabbatical that started in August 2013.

Josef Widder from TU Vienna, Austria, spent 6 weeks in Nancy in October and November 2013 as an Inria invited researcher. Together with Stephan Merz, he worked on the formalization of parameterized model checking techniques for fault-tolerant distributed algorithms in a proof assistant.

Mike Poppleton from the University of Southampton and Hoang Thai Son from ETHZ spent a week in our group for developing techniques to integrate fairness in Event B models, on the basis of the work published at IFM 2013 [17].

8.4.1.1. Internships

Luis Esteban Campostrini

Subject: Formal Verification of Distributed Algorithms

Date: from May until October, 2013

Institution: Universidad National de Rosario (Argentina)

Joint supervision with Martin Quinson (AlGorille team)

Anisia Maria Magdalena Tudorescu

Subject: Integrating SMT solvers into Spike

Date: from March 2013 until May 2013

Institution: West Timisoara University (Romania)

Joint supervision with Christophe Ringeissen (Cassis team) and Sorin Stratulat (Pareo team)

Paula Chocrón

Subject: Non-disjoint combination for SMT solvers: sharing a fragment of arithmetic

Date: from September 2013 until December 2013

Institution: University of Buenos Aires (Argentina)

Joint supervision with Christophe Ringeissen (Cassis team)

CALVI Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- Takashi Hattori, Simon Labrunie and Jean Rodolphe Roche participate in the ANR project "CHROME" (Heating, Reflectometry and Waves for Magnetized Plasma), grouping researchers from Université Paris 6 (B. Després, M. Campos Pinto and others), the Inria project-team POEMS (E. Bécache, C. Hazard and P. Joly) and Université de Lorraine (S. Heuraux). Simon Labrunie is the head of the Lorraine team.

  The CHROME project seeks to develop advanced mathematical and numerical tools for the simulation of electromagnetic waves in strongly magnetized plasmas (e.g., tokamak plasmas) in the context of reflectometry (a technique for probing the plasma by analysing the propagation of electromagnetic waves) and heating.

- GYPSI project (2010–2014), https://sites.google.com/site/anrgypsi/: coordinator Philippe Ghendrih (CEA Cadarache), other participants, University of Marseille, Universities of Strasbourg and Nancy (CALVI project-team). The aim is to understand the physics of turbulence in magnetically confined plasma using numerical simulation

- ANR project "PEPPSI" in Programme Blanc SIMI 9 – Sciences de l'ingénierie (Edition 2012) started in 2013. Participants : Giovanni Manfredi (coordinator), Edwin Chacon Golcher, Sever Hirstoaga.

8.1.2. Euratom-CEA projects

- Michel Mehrenberger and Philippe Helluy are local coordinators of the project FR FCM (CNRS Federation on Magnetic Confinement Fusion), within Euratom-CEA association, Title:"Numerical Methods for GYSELA", the goal is to help improving the numerical algorithms used by the GYSELA code developed at CEA Cadarache for the simulation of turbulence in magnetic fusion plasmas.

- Jean R. Roche is the coordinator of the FR FCM project with Euratom-CEA association, Title: "Full wave modeling of lower hybrid current drive in tokamaks". The goal of this project is to develop a full wave method to describe the dynamics of lower hybrid current drive problem in tokamaks.

8.2. International Research Visitors

8.2.1. Visits to International Teams

Michel Mehrenberger, since September 2013, Institut für Plasma Physics (IPP) Munich, Germany.

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

6. Partnerships and Cooperations

6.1. Regional Initiatives

In collaboration with B. Lévy (EPI ALICE), X. Antoine obtained a 25000 euros grant from Région Lorraine (projets émergents).

6.2. National Initiatives

6.2.1. ANR

Most of the members of our team are involved in at least one ANR program.

Thomas Chambrion has been responsible for the quantum control part of the ANR blanc project GCM from 2009 to December 2013.

Marius Tucnsak is local coordinator of ANR blan project Hamecmopsys. This ANR project will be active up to 2015.

Antoine Henrot is head of the ANR blanc project OPTIFORM since September 2012. This project is devoted to the Geometric Analysis of Optimal Shapes. It gathers scientist from Grenoble, Chambéry, Lyon, Rennes and Paris Dauphine. This ANR project will be active up to August 2016.

Xavier Antoine is coordinator for partner 2 of ANR blanc project BECASIM since September 2013. This ANR project will be active up to 2017.

6.3. International Initiatives

6.3.1. Inria International Partners

6.3.1.1. Informal International Partners

Most of the members of our team have regular collaborations with colleagues in abroad institutions.

Let us mention two new collaborations of Xavier Antoine with E. Lorin and A.D. Bandrauk (from Université de Carleton, Canada) and CRM, Montréal on one hand and with W. Bao (National University of Singapore) on the other hand. These two independent collaborations both deal with numerical computations in quantum mechanics (quantum chemistry and Bose-Einstein condensates).

6.4. International Research Visitors

6.4.1. Visits of International Scientists

George Weiss has been invited in our team for three months. This invitation was part of the " Chercheur d'excellence" program of Région Lorraine.

Ademir Fernando Pazoto visited our team during March 2013.

Fernando José Henriquez Barraza visited our team from February to June 2013.

6.4.2. Visits to International Teams

Marius Tucnsak was invited in the University of Wuhan (one month).

TOSCA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- N. Champagnat, J. Claisse and D. Villemonais are members of the ANR MANEGE (Modèles Aléatoires eN Écologie, Génétique et Évolution, ending in April 2014) whose aim is to provide methodological and conceptual advances in the study of stochastic processes modeling ecology, population genetics and evolution of life. This work is sustained by regular exchanges with biologists from several teams in France. In addition, the three working groups that operate in each of the three poles of the MANEGE project (Paris, Palaiseau, Marseille) gather all local probabilistic interests in the issues of this project. http://www.cmap.polytechnique.fr/~anr-manege/index_en.html

- A. Lejay is member of the ANR SIMUDMRI (Simulation of diffusion MRI signals in biological tissues) which started in November 2010 (directed by Jing-Rebecca Li, Inria Rocquencourt). http://www.cmap.polytechnique.fr/~jingrebeccali/grants/simudmri.html

- A. Lejay is member of the ANR H2MNO4 (ANR Cosinus, 2012–2015) on Original Optimized Object Oriented Numerical Model for Heterogeneous Hydrogeology which started in November 2012 (directed by Joceyline Erhel, IRISA, Rennes).

8.1.2. Contract with ADEME

Participant: Mireille Bossy.

Modéol   Since April 2013, M. Bossy is the coordinator of the Modéol collaboration project funded by the French Environment and Energy Agency (ADEME), and involving the IPSL (CNRS) and the French company Maïa Eolis. The overall goal of the project concerns the modeling and prediction of wind potential in France, in particular the quantification of uncertainties and the analysis of multi-scale variability.

Concerning the Inria workpackage, in collaboration with Antoine Rousseau, from the project-team Moise, M. Bossy introduced the terrain elevation in the SDM modelling. Selim Kraria is starting to work in Modéol. This year we also work on the interface of SDM with the classical and widely used numerical weather prediction solver WRF. For the visualisation purpose with the SDM outputs, we also retained the Num3sis platform developed at Inria Sophia Antipolis - Méditerranée.

8.2. International Initiatives

8.2.1. Inria Associate Teams

8.2.1.1. ANESTOC

Title: Stochastic modelling of renewable energies

Inria principal investigator: Denis Talay

International Partner (Institution - Laboratory - Researcher):

Pontificia Universidad Católica de Chile (Chile) - ANESTOC - Denis Talay

Duration: 2011 - 2013

See also: http://www.anestoc.cl/es/?page_id=1112

This associate team complements a CIRIC research program in Chile. We refer to the TOSCA-ANESTOC project on stochastic modelling of renewable energies, especially wind farms, and oceanic resources. Our associate team ("équipe associée Inria") will conduct its joint research at two different levels. Firstly, the mathematical work on its own which we have called the "Mathematical Kernel" (MK), motivated by a number of fundamental problems raised by the specific applications in which we are interested. The second level of research concerns two main axes of Applications: (A1) Applications to Engineering (Renewable energies) and (A2) Applications to Neuroscience. The Mathematical Kernel includes a number of fields in the domains of Stochastic Analysis, Statistics and Numerical Analysis. In particular, it is worth mentioning the following: 1. Probabilistic resolution of Boussinesq non-linear partial differential equations; 2. Stochastic Lagrangian modelling for wind simulation at small scale; 3. Open system dynamics as a bridge between Molecular Dynamics and Stochastic Differential Equations; 4. Inference on Stochastic Processes. 5. Algorithms and simulation. The Applications include the stochastic modelling of renewable energy through ocean resources and wind farms (CIRIC-subproject). This subject will be developed with engineers of Fundacion Inria Chile. In addition, applications to ion-channel dynamics through cell membranes will be considered jointly with biophysicists of the CINV (Neuroscience Centre of Valparaíso).

8.2.1.2. Informal International Partners

The TOSCA team project has collaborations with researchers in Japan (Ritsumeikan and Hosei University), Uruguay (Universidad de la República), ...

8.2.2. Inria International Labs

The CIRIC Team on *Stochastic Analysis of Renewable Energies: Ocean Energy and Wind Farms; dynamics and numerics* (2012-2014) is managed by TOSCA and ANESTOC (Univ Catolica, Santiago). It is composed of three main projects.

Mireille Bossy is managing the WINDPOS project, in collaboration with Antoine Rousseau (MOISE team) and three engineers of Inria Chile, Cristian Paris, José Espina Dote and Jacques Morice. Based on the stochastic Lagrangian modeling of the wind at small scale (see SDM SOFTWARE), WINDPOS aims to develop a wind farm simulator software, able to provide fine statistical information for the managing of electricity production.

This year the WINDPOS project focused on the introduction on wind mills modeling in the SDM software. This modeling is based on actuator disk and actuator line models. We also introduced inflow/outflow boundary conditions in SDM and added a CIC averaging in order to refine the input for the projection/pressure computation.

8.2.3. Participation In other International Programs

8.2.3.1. Math Amsud project SIN
Participant: Etienne Tanré.

The Math Amsud project SIN (Stochastic, Inference, Neuroscience) started in 2013. We worked on the part concerned by the stochastic modelling in neuroscience.

It is likely that the stochastic components play an important role in the functions of the neurons and of the networks they form. We describe and study the effect of the noise at different scales of neural activity, such that the level of the ionic channels and the level of neural networks, which are responsible for conveying and processing the information coded in sequences of spikes. The most popular models of this class are integrate and fire (LIF) neural networks. We study the synchronization of neurons in those networks.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- The TOSCA *seminar* organized by J. Inglis in Sophia Antipolis has received the following speakers: Eric Luçon (Technische Universität, Berlin), Julien Reygner (UPMC), Khaled Bahlali (Université du Sud Toulon-Var), Bertrand Cloez (Laboratoire d'Analyse et de Mathématiques Appliquées Université Paris-Est - Marne-la-Vallée), Michael Mascagni (Florida State University), Camillo Garcia Trillos (Laboratoire J.A. Dieudonné Nice), Pierre Guiraud (CIMFAV Facultad de Ingenieria, Universidad de Valparaíso), Laurent Michel (Laboratoire J.A. Dieudonné Nice), François Delarue (Laboratoire J.A. Dieudonné Nice).

- L. Beznea (Simion Stoilow of the Institute of Mathematics of the Romanina Academy) has been visiting TOSCA Nancy for two weeks in May and June.

8.3.1.1. Internships

Jonathan Alif

      Subject: Étude des grandes variations du modèle de Heston

      Date: from May 2013 until August 2013

      Institution: Université de Lorraine

Maimoun Ben Taher

      Subject: Real options for electricity production

      Date: from Feb 2013 until May 2013

      Institution: École Polytechnique de Tunisie (Tunisia)

Louis Capietto

      Subject: Networks with several populations of neurons

      Date: January-June 2013

      Institution: École Centrale de Lyon

Benoît Henry

      Subject: Population genetics and ancestral inference for continuous time branching processes

      Date: from March 2013 until September 2013

      Institution: Université de Lorraine

Alexis Papic

      Subject: First Passage Times

      Date: March 2013

      Institution: PUC (Chile)

Khaled Salhi

      Subject: Risk measures: detection of crisis periods and computation of Value-at-Risk

      Date: from March 2013 until September 2013

      Institution: Université de Lorraine

Shih Hau Tan

      Subject: Towards efficient risk quantification using GPUs and variance reduction techniques

      Date: from April 2013 until September 2013, in co-advising with Françoise Baude (OASIS team)

      Institution: Erasmus Mundus MathMods Program, University of Nice Sophia-Antipolis

8.3.2. Visits to International Teams

- J. Inglis was invited for one week by B. Zegarlinski to Imperial College London in January.

<p style="text-align:center"><strong style="color:red">CORTEX Team</p>

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR project PHEROTAXIS

Participants: Dominique Martinez, Thomas Voegtlin.

How can animals so successfully locate odor sources? This apparently innocuous question reveals on analysis unexpectedly deep issues concerning our understanding of the physical and biological world and offers interesting prospects for future applications. Pherotaxis focuses on communication by sex pheromones in moths. The main aim of the project is to integrate the abundant experimental data on the pheromone plumes, neural networks and search behaviour available in the literature, as well as that collected or being collected by us at the molecular, cellular, systemic and behavioural levels into a comprehensive global model of the pheromonal olfactory processes. To reach this objective, the consortium combines several groups of specialists with different and complementary fields, in physics (Institut Pasteur IP), neurobiology (INRA) and bio-robotics (Inria).

7.1.2. ANR project KEOPS

Participant: Carlos Carvajal-Gallardo.

This «ANR Internal White Project» involving NEUROMATHCOMP and CORTEX (and now MNEMOSYNE since most Cortex members involved in ths project are now in this team) Inria EPI in France with the U. of Valparaiso, U. Tecnica Frederico Santa-Maria, and U. De Chili is a 3 years, 248 person-months, sensory biology, mathematical modeling, computational neuroscience and computer vision, project addressing the integration of non-standard behaviors from retinal neural sensors, dynamically rich, sparse and robust observed in natural conditions, into neural coding models and their translation into real, highly non-linear, bio-engineering artificial solutions. An interdisciplinary platform for translation from neuroscience into bioengineering will seek convergence from experimental and analytical models, with a fine articulation between biologically inspired computation and nervous systems neural signal processing (coding / decoding).

7.2. International Initiatives

7.2.1. Participation In other International Programs

Conacyt project with Mexico (2010-2013):

We work with the Cinvestav Tamaulipas research center (Mexico), on the analysis, methods and techniques for the embedded implementation of massively distributed bio-inspired connectionist processing for perception tasks on reconfigurable devices under a hardware/model codesign approach, through a project funded by the Mexican ministry Conacyt. Our works were mostly oriented towards the study of the properties of massively distributed elementary computations in bio-inspired models for vision in order to provide efficient implementation into reconfigurable logic devices. Other activities extended our works to sensori-motor systems, including embedded control of low-level locomotion by means of CPG models (central pattern generators).

7.3. International Research Visitors

7.3.1. Visits of International Scientists

7.3.1.1. Visiting professors/researchers

Chahinez Meriem BENTAOUZA (December 2013)

Funding: University of Mostaganem

Subject: Etude bibliographique de méthodes d'apprentissage statistique pour l'analyse de signaux médicaux

Institution: University of Mostaganem, Algeria

Fatiha HENDEL (April 2013)

Funding: University of Oran

Subject: Apprentissage et classification automatique

Institution: University of Oran, Algeria

Cesar TORRES-HUITZIL (July 2013)

Funding: Conacyt project

Subject: Hardware implementations of neural networks

Institution: Cinvestav Tamaulipas, Mexico

7.3.1.2. Internships

Hariharan NATANASIHAMANI (from May 2013 until Sep 2013)

Subject: Develomental reinforcement learning

Institution: McGill University, Canada

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

8. Partnerships and Cooperations

8.1. National Initiatives

- *Optique-PDT* (2012-2014), mOdélisation et oPTimisation de l'Irradiance dans les tissus biologiQUEs hétérogènes traités par Thérapie PhotoDynamique interstitielle, Funding organism: *PEPS CNRS-INSERM-Inria*, Leader: M. Thomassin (CRAN, U. Lorraine).

- *Nano-Xrays* (2011-2014), Nanoparticles-based X ray-induced photodynamic therapy in glioblastoma multiforme, Funding organism: *Institut National du Cancer (INCa)*, Leader: M. Barberi-Heyob (CRAN, U. Lorraine).

- *PDTX* (2010-2013), Active Nanoplatforms for Photodynamic Therapy, Funding organism: *French National Agency for Research (ANR)*, Leader: M. Verelst (U. Paul Sabatier, Toulouse).

- *MASTERIE* (2010-2013), Malliavin Stein Random Irregular Equation, Funding organism: *French National Agency for Research (ANR)*, Leader: F. Russo (ENSTA, Paris).

8.2. European Initiatives

8.2.1. FP7 Projects

- *Target-PDT* (2009-2013), Photodynamic Therapy using photosensitizer-doped targeted organic nanoparticles, Funding organism: FP7 ERA-NET EuroNanoMed: **European Innovative RTD Projects Proposals in Nanomedicine**, Leader: P. Boisseau (CEA LETI, Grenoble).

<h2 style="color:red; text-align:center">MASAIE Project-Team</h2>

6. Partnerships and Cooperations

6.1. International Initiatives

6.1.1. Inria International Labs

MASAIE is the Inria EPI partner of GRIMCAPE (LIRIMA). It also has strong collaboration with M2IPE2S (LIRIMA). Two PhD students (Diaby and Diouf) are members of M2IPE2S.

G. Sallet has participated to "Journées du LIRIMA", Rabat, Morocco, September 17th-19th, 2013.

6.1.2. Participation In other International Programs

6.1.2.1. CAPES-COFECUB
MASAIE is the french correspondent in a cooperation program with Brazil. This project, funded by CAPES-COFECUB, "new methods in epidemiology and early detection of events" has begun in January 2011.
A Brazilian network has been built in 2011, and it is composed of

- FGV (Fundação Getulio Vargas) Rio de Janeiro. Principal investigator: Jair Koiller.
- UFF (Universidade Federal Fluminense) Rio de Janeiro. Principal investigator: Max Oliveira de Souza.
- UNICAMP (Universidade Estadual de Campinas) Campinas. Principal investigator: Hyun Mo Yang.
- Fondation Oswaldo Cruz (Fiocruz, Rio). Principal investigator: Claudia Codeço.
- IMPA Rio de Janeiro. Principal investigator: Jorge Zubelli.

6.1.2.2. PAES-UEMOA
A research project on Bilharzia was deposed November 2, 2012, by the universities of Ouagadougou and Gaston Berger of Saint-Louis, in the framework of PAES(projet d'appui à l'enseignement supérieur) of UEMOA (Union Economique et Monétaire de l'Afrique de l'Ouest). MASAIE is an important component of this network. This project has been accepted July, 1, 2012 and funded with 30 000 000 CFA (XOF) ($\approx$ 45 000 euro).
The Phd thesis of Lena Tendeng and M. Diaby (MASAIE and UGB St Louis) are part of this project.

6.2. International Research Visitors

6.2.1. Visits of International Scientists

Jorge Zubelli, professor at IMPA, Rio de Janeiro, Brazil, december 2013. We started a collaboration on the analysis of PDE models for stage-structured intra-host models.

6.2.2. Visits to International Teams

In the framework of CAPES-COFECUB, G. Sallet has visited FGV and UFF (Rio de Janeiro) from March 2 to March 11, and from November 4 to November 16, 2013. A. Iggidr has visited FGV and UFF (Rio de Janeiro) and UNICAMP (Sao Paulo) from April 19 to May 12 and from October 22 to November 12, 2013.

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

7. Partnerships and Cooperations

7.1. Regional Initiatives

In the *Contrat de Projet État Région (CPER) Action Modeling, Simulation and Interaction* (2009-2014), we are contributing to the axis *Situed Informatic* through the project CoBras for controlling a jaco robotic arm using EEG. Contact in Neurosys is Laurent Bougrain.

7.2. National Initiatives

7.2.1. ANR

We participate in the project *Keops:* Algorithms for modeling the visual system: From natural vision to numerical applications (2011-2014).

A recent description in the retina of non-standard ganglion cells types, beside a complex repertoire of standard ganglion cells, responses in front of natural stimulus and conveys important questions about the real, early processing capacity of the retina. This leads to revisit both the neural coding of the information the eye is sending to the brain, and also sheds light to engineering applications from the understanding of such encoding, as detailed in the sequel. At the modeling level, retinal cells are mainly formalized using a LN (Linear spatio-temporal filtering followed by a static Non-linear transduction), while an important fraction of non-standard cells response cannot be represented in such a model class. This is a challenge to develop an innovative formalism that takes such complex behaviors into account, with such immediate applications as new dynamical early-visual modules. Proposing new innovative bioinspired formalisms in order to perform dynamical visuo-perceptual tasks adapted to natural environment is a main goal of this project, with a special focus to scenes including complex visual motion interacting with light.

The project is a cooperation between the University of Nice (France), the University of Valparaiso (Chile), the Pontifical Catholic University of Chile in Santiago de Chile, the Inria teams NeuroMathComp, Mnemosyne, Cortex and Neurosys.

7.2.2. Others

- Inria Technological development action (ADT): OpenViBE-NT
  This is a two-year multi-site project (2012–2014) to develop OpenViBE further on several fronts such as usability, new algorithms and scope of applicability. Teams of the ADT are Hybrid(Rennes), Athena (Sophia), Potioc (Bordeaux) and Neurosys. Coordinator is Laurent Bougrain.

- Multidisciplinary Exploratory Project (PEPS 2013) Bio-Maths-Info (BMI): *Characterising the laminar profile of motor cortical oscillatory synchronization during visuomotor behavior with new analysis tools.*
  Oscillations are omnipresent in the brain, but their function is still disputed. In motor cortex, beta and gamma oscillations are often observed, but their proposed roles in sensorimotor behavior are largely overlapping. While much is known on the laminar distribution of oscillations in sensory areas, the very sparse data on the laminar profile of motor cortical oscillations largely limits their functional interpretations. The 2-years project studies the layer specificity of monkey motor cortical oscillations and oscillatory interactions between M1 and PMd during visuomotor behavior. Extending conventional tools, such as coherency analysis, Neurosys develops a new method to quantify short-lasting partial amplitude and phase synchronization in single-trial data, based on wavelets, exploiting the predefined vicinity of contacts on the laminar probes. The application of this new method to the data recorded in Marseille will reveal instantaneous amplitude and phase synchronization between cortical layers and between the brain areas M1 and PMd, providing novel insights into the functional roles of beta and gamma oscillations in visuomotor behavior. The experimental partner at the *Institut de Neurosciences de la Timone* in Marseille is Bjork Kilavik, the contact in Neurosys is Axel Hutt.

7.3. European Initiatives

7.3.1. FP7 Projects

The *ITN*-project *Neural Engineering Transformative Technologies (NETT)* (2012-2016) is a Europe-wide consortium of 18 universities, research institutes and private companies which together hosts 17 PhD students and 3 postdoctoral researchers over the next 4 years. Neural Engineering brings together engineering, physics, neuroscience and mathematics to design and develop brain-computer interface systems, cognitive computers and neural prosthetics. Neurosys will host a PhD-student for three months in winter 2014/2015. Contact is Axel Hutt.

7.3.2. Collaborations in European Programs, except FP7

Program: ERC Starting Grant
Project acronym: MATHANA
Project title: Mathematical Modeling of Anaesthesia
Duration: January 2011 – December 2015
Coordinator: Axel Hutt
Abstract: MATHANA aims to study mathematically spatially extended neural systems and reveal their spatio-temporal dynamics during general anaesthesia.

7.4. International Initiatives

7.4.1. Informal International Partners

- We collaborate with Jamie Sleigh (University of Auckland, New Zealand), who provides us with experimental EEG-data obtained in humans during anaesthesia (A. Hutt).
- In the collaboration with Flavio Frohlich (University of North Carolina - Chapel Hill), we receive experimental data measured intracranially in ferrets and analyse them on spectral properties (A. Hutt).
- The collaboration with Matthias Munk (Max Planck Institute for Biological Cybernetics in Tuebingen) lasts for over 10 years now and provides us with experimental Local Field Potentials measured during a visuomotor task of monkeys (A. Hutt).
- The collaboration with Linghai Zhang (Lehigh University, USA) on the mathematical analysis of neural field equations led to a publication in 2013 [6] (A.Hutt).
- In the collaboration with Jeremy Lefebvre (University in Geneva), we have been working out together a novel stochastic center manifold analysis method for delayed differential equations leading to new insights into the effects of additive noise close to bifurcation points (A. Hutt).
- The collaboration with Marina Palazova and Torsten Schubert (Humboldt University Berlin) on priming effects of subliminal visual stimuli has led to a publication in 2013 [8] (A. Hutt).
- The collaboration with Peter beim Graben (Humboldt University Berlin) on recurrence data analysis stimulated us to intensify our work on meta-stable states in neural systems (A. Hutt).
- An Inria Internship proposal has been submitted on topics that will involve Pr. Motoharu Yoshida at the Ruhr University Bochum, Germany, to study the role of persistent firing neurons in memory and more specifically in neural network synchronization. M. Yoshida provides us with biological data that we combine with simulations to test hypotheses on memory formation (L. Buhry).
- We also collaborate with Pr. John Rinzel (New York University, USA) and Pr. LieJune Shiau (University of Houston, Texas, USA) on more theoretical approaches concerning the role intrinsic neuronal dynamics in network synchronization and brain oscillations (L. Buhry).

7.5. International Research Visitors

7.5.1. Visits of International Scientists

We have hosted the visiting professors Peter beim Graben (Humboldt University Berlin, September–October) and Jamie Sleigh (September–October) to join forces in our common project on the analysis of multivariate EEG-data obtained during anaesthesia.

7.5.2. Visits to International Teams

Pedro Garcia Rodriguez works on stochastic transitions in neural systems and he has visited the group of Prof. Schimansky-Geier at Humboldt University Berlin in December for one week to start a future collaboration.

<div align="center">

SHACRA Project-Team

</div>

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Sofa, ADT

SOFA Large Scale Development Initiative (ADT) : the SOFA project (Simulation Open Framework Architecture) is an international, multi-institution, collaborative initiative, aimed at developing a flexible and open source framework for interactive simulations. This will eventually establish new grounds for a widely usable standard system for long-term research and product prototyping, ultimately shared by academic and industrial sites. The SOFA project involves 3 Inria teams, SHACRA, IMAGINE and ASCLEPIOS. The development program of the ADT started in 2007.

8.1.2. ANR Acoustic

The main objective of this project is to develop an innovative strategy based on models for helping decision-making process during surgical planning in Deep Brain Stimulation. Models will rely on different levels involved in the decision-making process; namely multimodal images, information, and knowledge. Two types of models will be made available to the surgeon: patient specific models and generic models. The project will develop methods for 1) building these models and 2) automatically computing optimal electrodes trajectories from these models taking into account possible simulated deformations occurring during surgery. The project belongs to the multidisciplinary domain of computer-assisted surgery (CAS). Computer assisted surgery aims at helping the surgeon with methods, tools, data, and information all along the surgical workflow. More specifically, the project addresses surgical planning and surgical simulation in Image Guided Surgery. It is related to the exponentially growing surgical treatment of Deep Brain Stimulation (DBS), originally developed in France by Pr. Benabid (Grenoble Hospital). The key challenges for this research project are 1) to identify, extract, gather, and make available the information and knowledge required by the surgeon for targeting deep brain structures for stimulation and 2) to realistically simulate the possible trajectories.

8.1.3. IHU, Strasbourg

Our team has been selected to be part of the IHU of Strasbourg. This new institute, for which funding (67M€) has just been announced, is a very strong innovative project of research dedicated to future surgery of the abdomen. It will be dedicated to minimally invasive therapies, guided by image and simulation. Based on interdisciplinary expertise of academic partners and strong industry partnerships, the IHU aims at involving several specialized groups for doing research and developments towards hybrid surgery (gesture of the surgeon and simulation-based guidance). Our group and SOFA have a important place in the project. Since September 2011 a part of our team is located within the IHU, to develop a number of activities in close collaboration with clinicians.

8.1.4. ANR IDeaS

IDeaS is a project targeted at per-operative guidance for interventional radiology procedures. Our main goal is to provide effective solutions for the two main drawbacks of interventional radiology procedures, namely: reduce radiation exposure and provide a fully 3D and interactive visual feedback during the procedure. To do so, our project relies on an original combination of computer vision algorithms and interactive physics-based medical simulation. Computer vision algorithms extract relevant information (like the actual projected shape of the guide-wire at any given time) from X-ray images, allowing adjusting the simulation to real data. Conversely, computer-based simulation is used as a sophisticated and trustful predictor for an improved initialization of computer vision tracking algorithms. Many outcomes may be expected both in scientific and clinical aspects. On the scientific side, we believe a better understanding of how real data and

simulation should be merged and confronted must lead, as a natural by-product, to image-based figures of merit to actually validate computer-based simulation outputs against real and dynamic data. A more accurate identification of the factors limiting the realism of simulation should follow with a rebound impact on the quality of the simulation itself. An actual integration of a mechanical model into the loop will improve the tracking. We firmly believe mechanical constraints can supplement the image data such that dynamic single view reconstruction of the interventional devices will be possible. On the clinical side, using the prediction capabilities of the simulation may decrease the need for X-ray images at high rates, thus leading to lower exposure to radiations for the patients and surgical staff. Finally, the output of the simulation is the 3D shape of the tool (e.g. guide-wire or catheter), but not only. Additional information may be visualized, for instance pressure of the catheter on the arterial wall, to prevent vessel wall perforations, or reduce stress on the arterial wall to prevent spasm. More generally, richer information on the live procedure may help surgeons to reduce malpractice or medical errors.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. RASimAs

Type: COOPERATION

Defi: NA

Instrument: Specific Targeted Research Project

Objectif: NC

Duration: nov 2012 - oct 2015

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

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

Inria contact: Stéphane Cotin

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

8.3. International Initiatives

8.3.1. Participation In other International Programs

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

8.4. International Research Visitors

8.4.1. Visits to International Teams

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

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

7. Partnerships and Cooperations

7.1. Regional Initiatives

CPER MISN, EDGE project (2010-2013, 518k€).   M. Quinson and L. Nussbaum are leading a project of the regional CPER contract, called *Expérimentations et calculs distribués à grande échelle* (EDGE). It focuses on maintaining and improving the local Grid'5000 infrastructure, and animating both the research on experimental grids and the research community using these facilities. More information is available at http://misn.loria.fr/spip.php?rubrique8.
Other partners: EPI CARAMEL, VERIDIS

Lorraine Region (2011-2013, 30k€).   The project *"Systèmes dynamiques : étude théorique et application à l'algorithmique parallèle pour la résolution d'équation aux dérivées partielles"* lead by S. Contassot-Vivier is the sequel of his research on dynamical systems and consists in designing more efficient algorithmic schemes for parallel iterative solvers. This project is closely linked to the collaboration with the Lemta as the real case application provided by F. Asllanaj will be the target of our future developments in this field.

7.2. National Initiatives

7.2.1. ANR

Plate-form(E)[3]   (2012-2015, 87k€) has been accepted in 2012 in the ANR SEED program. It deals with the design and implementation of a multi-scale computing and optimization platform for energetic efficiency in industrial environment. It gathers 7 partners either academic (LEMTA, Fédération Charles Hermite (including AlGorille), Mines Paris, INDEED) or industrial (IFP, EDF, CETIAT). We will contribute to the design and development of the platform.

ANR SONGS   (2012–2015, 1800k€) Martin Quinson is also the principal investigator of this project, funded by the ANR INFRA program. SONGS (Simulation Of Next Generation Systems) aims at increasing the target community of SimGrid to two new research domains, namely Clouds (restricted to the *Infrastructure as a Service* context) and High Performance Computing. We develop new models and interfaces to enable the use of SimGrid for generic and specialized researches in these domains.

As project leading team, we are involved in most parts of this projects, which allows the improvement of our tool even further and sets it as the reference in its domain (see Section 6.3.1).

7.2.2. Inria financed projects and clusters

AEN Hemera   (2010-2013, 2k€) aims at demonstrating ambitious up-scaling techniques for large scale distributed computing by carrying out several dimensioning experiments on the Grid'5000 infrastructure, and at animating and enlarging the scientific community around the testbed. M. Quinson, L. Nussbaum and S. Genaud lead three working groups, respectively on *simulating large-scale facilities*, on *conducting large and complex experimentations on real platforms*, and on *designing scientific applications for scalability*.
Other partners: 20 research teams in France, see https://www.grid5000.fr/mediawiki/index.php/Hemera for details.

ADT Aladdin-G5K (2007-2015, 200k€ locally)   aims at the construction of a scientific instrument for experiments on large-scale parallel and distributed systems, building on the Grid'5000 testbed (http://www.grid5000.fr/). It structures INRIA's leadership role (8 of the 9 Grid'5000 sites) concerning this platform. The technical team is now composed of 10 engineers, of which 2 are currently hosted in the AlGorille team. As a member of the executive committee, L. Nussbaum is in charge of following the work of the technical team, together with the Grid'5000 technical director.
Other partners: EPI DOLPHIN, GRAAL, MESCAL, MYRIADS, OASIS, REGAL, RESO, RUN-TIME, IRIT (Toulouse), Université de Reims - Champagne Ardennes

ADT Kadeploy   (2011-2013, AlGorille is the only partner, 90k€) focuses on the Kadeploy software, a tool for efficient, scalable and reliable cluster deployment. It is used on several clusters at INRIA and playing a key role on the Grid'5000 testbed. This ADT allows the continuation of the development to improve its performance, reliability and security, and aims at a larger distribution to industry and other INRIA platforms with similar needs.

ADT Solfége   (2011-2013, AlGorille is the only partner, 100k€), for *Services et Outils Logiciels Facilitant l'Experimentation à Grande Échelle* aims at developing or improving a tool suite for experimentation at large scale on testbeds such as Grid'5000. Specifically, we will work on control of a large number of nodes, on data management, and on changing experimental conditions with emulation. E. Jeanvoine (SED) is delegated in the AlGorille team for the duration of this project.

ADT Cosette   (2013-2015, AlGorille is the only partner, 120k€), for *COherent SET of Tools for Experimentation* aims at developing or improving a tool suite for experimentation at large scale on testbeds such as Grid'5000. Specifically, we will work on (1) the development of Ruby-CUTE, a library gathering features useful when performing such experiments; (2) the porting of Kadeploy, Distem and XPFlow on top of Ruby-CUTE; (3) the release of XPFlow, developed in the context of Tomasz Buchert's PhD; (4) the improvement of the Distem emulator to address new scientific challenges in Cloud and HPC. E. Jeanvoine (SED) is delegated in the AlGorille team for the duration of this project.

INRIA Project Lab MC   (2012-) Supporting multicore processors in an efficient way is still a scientific challenge. This project introduces a novel approach based on virtualization and dynamicity, in order to mask hardware heterogeneity, and to let performance scale with the number and nature of cores. Our main partner within this project is the Camus team on the Strasbourg site. The move of J. Gustedt there, will strengthen the collaboration within this project.

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. FED4FIRE

Participant: Lucas Nussbaum.

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.

Lucas Nussbaum started participating in the project in September 2013, mainly with an expert role.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

7.4.1.1. Internships

Maximiliano Geier

Subject: Leveraging multiple experimentation methodologies to study P2P broadcast

Date: from Sep 2012 until Mar 2013

Institution: University of Buenos Aires (Argentina)

Ahmed Bessifi

Subject: Reliability and Scalability improvements in Kadeploy

Date: from Mar 2013 until Aug 2013

Institution: Université de Tunis El Manar - Faculté des Sciences (Tunisia)

Luis Esteban Campostrini

Subject: Formal Verification of Distributed Algorithms

Date: from May 2013 to Oct 2013

Institution: Universidad National de Rosario (Argentina)

Rodrigo Campos

Subject: Ordered Read-Write Locks on Multicore Architectures

Date: from Mar 2013 until Aug 2013

Institution: University of Buenos Aires (Argentina)

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

MADYNES is involved in Satelor, a regional research and development project funded by the AME (Agence de Mobilisation Economique) of Lorraine (October 2013 – September 2016). The consortium includes academic (Univ. of Lorraine, Inria), medical (OHS) and industrial (Diatelic-Pharmagest, ACS, Kapelse, Salendra, Neolinks) partners. It aims at developing innovative and easily deployable AAL solutions for their effective use in the tele-homecare systems. Madynes team is mainly involved in the data collection system development based on wireless sensors and IoT technology.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. ANR Quasimodo

Participants: François Despaux, Abdelkader Lahmadi, Evangelia Tsiontsiou, Ye-Qiong Song [contact].

The QUASIMODO ANR Blanc international project (http://quasimodo.loria.fr/) is a fundamental research project coordinated by Prof. Ye-Qiong SONG at LORIA - University of Lorraine in France and by Prof. Youxian SUN at SKLICT of Zhejiang University in China. The project started on March 2011 for duration of 36 months. It is funded by ANR grant (ANR 2010 INTB 0206 01) and NSFC grant (NSFC 61061130563). The main objective of the project is to specify, develop and evaluate algorithms and mechanisms to provide the self-adaptive QoS support for real-time applications using wireless sensor networks (WSN). We extended queue-MAC to iQueue-MAC to support multi-hop transmission [23]. We also conducted measurement based performance evaluation of IEEE802.15.4 beacon enabled WSN to assess the usefulness of the existing Markov models [15], [14] for evaluating the end-to-end delay distribution. A new routing algorithm called Operator calculus has been intensively studied and its execution time has been compared with SAMCRA, showing the great potential of OC to be used in WSN routing.

8.2.2. PIA LAR

Participants: Kévin Roussel, Ye-Qiong Song [contact].

LAR (Living Assistant Robot) is a national project getting together Inria (MAIA and MADYNES teams, Credit Agricole, Diatelic and Robotsoft. The aim is to develop an ambient assisted living system for elderly including both sensors and assistive robots. The task of our team is the development of a WSN based system integrating both sensors of the environment and sensors and actuators embedded on a mobile robot. The research issues include the QoS, energy and mobility management. The first step consists in identifying and developing necessary support for realizing such a system. For this purpose we investigated several OS for WSN and proposed some enhancements to ContikiMAC and RiotOS.

8.2.3. Action de Développement Technologique

8.2.3.1. ADT Métroscope

This ADT is linked to the consortium Metroscope [5], whose goal is to understand the behavior of the Internet and its uses within a mobile environment. Through this ADT, funded by Inria, an engineer (Mohammad-Irfan Khan) was hired for 2 years (2013-2015). He will participate in the design and deployment of a distributed platform. This platform will be composed of a services providing measurement tools that collect a set of data and interact with probes located at various points of the network.

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[5] http://metroscope.eu/

8.2.3.2. ADT SEA

The goal of this ADT is to provide an novel security solution for Android platforms where the users will be able to evaluate the security level of their devices. The solution relies on the analysis and collection of logs and network activities of running Android applications to detect malicious activities and also the detection of vulnerable configurations of the device using an OVAL-based approach. Through, this ADT, funded by Inria, an engineer (Eric Finickel) was hired for 2 years (2013-2015). He is working on the development of Android devices embedded probes to export logs and network activities. He will also design and setup the collector and the analysis applications using a Hadoop based framework.

8.2.3.3. ADT PAL-PERCEE

The goal of this ADT (2012-2013) is to provide a multi-protocol gateway and a unified interface for easing transparent access to the heterogenous sensor data. Together with PAL partners, we specified a common data format and enriched the existing MPIGate by re-structing all using ROS middleware. The new MPIGate is operational in the smart apartment of LORIA and serves as the base for developing large scale AAL systems.

8.2.4. Actions d'Envergure Nationale

The Inria Large-scale initiative action AEN PAL project (http://pal.inria.fr) aims at providing technologies and services for improving the autonomy and quality of life for elderly and fragile persons. Communication is one of the key components for ensuring real-time data gathering and exchange between heterogeneous sensors and actuators (robots). Within PAL and thanks to the associated ADT PERCEE project described above, we extended MPIGate (http://mpigate.loria.fr). The development and tests are conducted using LORIA's smart apartment platform developed within CPER MISN Informatique située project (http://infositu.loria.fr). The adoption of ROS (Robotic Operating System) also facilitates the interoperability of our services with the services of the other PAL partners since the new PALGate is based on ROS.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. Univerself

> Type: COOPERATION
> Defi: The Network of the Future
> Instrument: Integrated Project
> Objectif: The Network of the Future
> Duration: September 2010 - August 2013
> Coordinator: Alcatel Lucent (France)
> Partner: Universiteit Twente, Alcatel Lucent Ireland, Alcatel Lucent Deutschland, Valtion Teknilli-nen Tutkimuskeskus (Finland), University of Piraeus, France Telecom, Telecom Italia, National University of Athens, Fraunhofer-Gesellschaft zur Foerderung 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).
> Inria contact: E. Fabre
> See also: http://www.univerself-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. Univerself has been launched in October 2010 and is scheduled for four years.

This FP7 European integrated project aims at consolidating the autonomic methods and techniques supporting the management of the future Internet, and at integrating these methods into a unified management framework (UMF). The objective of this framework is to address the management issues of the evolving Internet through the self-organization of the control plane and the empowerment of the management plane with cognition. Our work in the Univerself project mainly concerns the security and safety challenges posed by this unified management framework, with a special interest for the maintenance of safe configurations.

In the Year 2013, we have pursued our efforts on vulnerability management in autonomic networks and systems. In that context, we have worked on the adaptation of observation and operation methods to the specific needs of future networks and services, through the refinement of the Unified Management Framework (UMF) and its network empowerment modules (NEM). A particular focus has been given to methods for assessing past hidden vulnerable configurations [44] as well as techniques for minimizing the impact of the vulnerability assessment process on device resources [45]. We have therefore extended our vulnerability management strategy to the detection of systems compromised in the past by configuration vulnerabilities unknown at that moment, and considered a probabilistic cost-efficient assessment for dealing with resource-constrained environments by taking advantage of the statistical properties of vulnerability description sets.

We have also worked on the design of a configuration assessment service for the UMF framework. NEMs have particular requirements and specific configurations in order to work properly. The interconnections between hundreds of NEMs and the services provided by them increase the complexity of their configuration. This configuration assessment service aims at preventing configuration errors, conflicts between services and inconsistencies that can occur leading to severe operational problems as well as security issues within the framework itself. Even though operating systems where NEMs are deployed and also the NEMs themselves may have security solutions to be protected, such fact does not ensure the security of the whole framework.

8.3.1.2. FI-WARE

Type: COOPERATION

Defi: PPP FI: Technology Foundation: Future Internet Core Platform

Instrument: Integrated Project

Objectif: PPP FI: Technology Foundation:Future Internet Core Platform

Duration: September 2011 - May 2014

Coordinator: Telefonica (Spain)

Partner: Thales, SAP, Inria

Inria contact: Olivier Festor

See also: http://www.fi-ware.eu

Abstract: FI-WARE will deliver a novel service infrastructure, building upon elements (called Generic Enablers) which offer reusable and commonly shared functions making it easier to develop Future Internet Applications in multiple sectors. This infrastructure will bring significant and quantifiable improvements in the performance, reliability and production costs linked to Internet Applications, building a true foundation for the Future Internet.

The goal of the FI-WARE project is to advance the global competitiveness of the EU economy by introducing an innovative infrastructure for cost-effective creation and delivery of services, providing high QoS and security guarantees. FI-WARE is designed to meet the demands of key market stakeholders across many different sectors, e.g., healthcare, telecommunications, and environmental services. FI-WARE unites major European industrial actors.

The key deliverables of FI-WARE will be an open architecture and a reference implementation of a novel service infrastructure, building upon generic and reusable building blocks developed in earlier research projects. We will demonstrate how this infrastructure supports emerging Future Internet (FI) services in multiple Usage Areas, and will exhibit significant and quantifiable improvements in the productivity, reliability and cost of service development and delivery, building a true foundation for the Future Internet.

The MADYNES contributions to the FI-WARE project are:

- Sicslowfuzzer, a fuzzing framework for the Internet of Things, that allows to assess the robustness of IoT OSes and applications, networkwise. More specifically, the tool uses the Scapy library for packet manipulation, allows users to define interaction scenarios in XML and provides multiple mutation algorithms;

- Flowoid, a netflow probe for Android-based devices, which also provides a netflow location template to convey location information of the device;

- XOvaldi4Android, an OVAL interpreter for Android-based devices, that is able to retrieve OVAL definitions using a web service, use them to check the current status of the system, and publish a result, using a second web service;

- the coordination between the Security Work Package and the Inria teams involved in it. This includes the attending to weekly audio conferences, face to face meetings, and making sure deliverables and tasks were addressed in a timely manner.

8.3.1.3. Flamingo

Type: COOPERATION

Defi: Management of the Future Internet

Instrument: Network of Excellence

Objectif: Management of the Future Internet

Duration: November 2012 - October 2016

Coordinator: University of Twente (Netherlands)

Partner: University of Twente, Inria, University of Zurich, Jacobs University of Bremen, University des Bundeswehr Munich, Polytechnic University of Catalonia, Interdisciplinary Institute for Broadband Technology, University of Ghent, University College London

Inria contact: Olivier Festor

See also: http://www.fp7-flamingo.eu

Abstract: The FP7 FLAMINGO Network of Excellence is composed of 8 partner universities, with complementary knowledge and strong ties to industry. It covers the entire spectrum of network management core functions and application domains, which are required for building, integrating, and disseminating the knowledge of the management plane for the Future Internet.

The objectives of FLAMINGO are (a) to strongly integrate the research of leading European research groups in the area of network and service management, (b) to strengthen the European and worldwide research in this area, and (c) to bridge the gap between scientific research and industrial application. To achieve these goals, FLAMINGO performs a broad range of activities, such as to develop open source software, establish joint labs, exchange researchers, jointly supervise Ph.D. students, develop educational and training material, interact with academia and industry, organize event, and strongly contribute to (IETF and IRTF) standardization [40].

Our work on network and service monitoring [42] has focused on security attacks in RPL Networks, with a study of DODAG inconsistency attacks jointly with Jacobs University of Bremen. In a RPL network, a malicious node can create artificial DODAG inconsistencies by manipulating IPv6 header options, thereby leading to increased overhead, denial of service and even black-hole attacks that are hard to detect. Our work has consisted in evaluating the impact of DODAG attacks in a RPL network, identifying the key parameters that are required to detect these attacks, developing a mitigation strategy to reduce their effects. Efforts have also been done on a NetFlow/IPFIX Probe for android-based devices, jointly with University of Twente. The major achievements of this collaboration have been the development of a NetFlow and IPFIX metering process for Android devices, the extension of nfdump/Nfsen and SURFmap with location support, and a IETF draft describing a set of information elements for IPFIX metering process location.

We have also contributed to activities on automated configuration and repair [37], with an in-depth analysis and comparison of existing management architectures. In that context, we have elaborated a survey on autonomic vulnerability assessment, recently published in IEEE Communications Survey and Tutorial [3]. This survey introduces a classification, called D3, to structure the vulnerability assessment activity into three well-defined dimensions: Discovery, Description and Detection. Background and key concepts as well as different leading methods and current techniques have been discussed along this work. We have identified potential applications over diverse contributions that may provide a strong basis for achieving this critical goal within self-governing

systems. We have also pointed out several areas such as vulnerability integration models, collaborative vulnerability management approaches and policy-based reasoning systems where the development of novel approaches and solutions are required to provide autonomic environments with the ability of assessing their own exposure.

8.3.2. Collaborations in European Programs, except FP7

Type: COOPERATION

Defi: Crowdsourcing Services for Citizen in Digital Cities

Instrument: EIT ICT Labs

Objectif: Develop new essential services for city-grade crowd-sourcing platforms and to deploy them on different platforms dedicated to different types of crowd-sourcing activities.

Duration: January 2013 - December 2013

Coordinator: Inria (France)

Partner: Imperial College of London (UK), BME (HU), KTH (SW), SAP (GE), Cap-Digital (FR), Alcatel-Luccent (FR), Inria (FR)

Inria contact: Thomas Silverston

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

Abstract: the EIT ICT Labs activity CityCrowdSource is composed of 7 partners, among which 4 partner universities and 3 partner industries. This project tackles the Crowdsourcing services and propose three milestones for such emerging services: trust service, privacy service and process model.

The objective of CityCrowdSource is to develop three new services that are essential for city-grade crowd-sourcing platforms and to deploy and evaluate them on five different existing platforms dedicated to different types of crowd-sourcing activities.

The activity supports to leverage the potential of crowd-based applications in urban contexts. Crowd-based data collection in combination with official data will lead to a vastly improved coverage and quality of digital information for urban areas.The added-value of the proposal is in : (1) the three services: trust, privacy and crowd processes modeling that are not present in any crowd-sourcing platform available today, (2) in the deployment and of these services on top of different crowd-sorucing platforms and (3) the experimentation of these paltforms in real life city scenarios.

Our work in this activity has focused on the design, deployment and experimentation of CrowdOut, a crowdsourcing service for Road Safety. This service has been designed for Android platform and has been tested and evaluated. First, a prototype has been experimented during Futur-en-Seine, the Digital World Festival in Paris (June 2013). Second, we performed experiment in the Grand Nancy Urban Area. The CrowdOut User Interface received support from the Living Lab Inria Sophia-Antipolis.

From this work we published several papers into a national conference (Ubimob) [25].

8.3.3. Collaborations with Major European Organizations

University of Luxembourg (Luxembourg) : We have two ongoing PhD candidates with the SnT at University of Luxembourg. We collaborate on the topic of Large Scale Monitoring for Security Management. Target services are: P2P Networks, Virtual Coordinates Systems and DNS Services.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal International Partners

- University of Twente, The Netherlands, joint work with Professor Aiko Pras on large scale network monitoring and attack detection

- Jacobs University Bremen, joint PhD. with Professor Schoenwaelder on security management in wireless sensor networks
- Federal University of Rio Grande do Sul (UFRGS), joint work with Professor Granville on autonomic management systems
- University of the Federal Armed Forces, Munich Germany, joint work with Professor Gabi Dreo on cloud and mobile cloud security management

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

Younes Abid

> Subject: Development of a configuration service for Wireless Sensor Networks using a content centric approach
> Date: from Mar 2013 to Sep 2013
> Institution: Ecole Nationale des Sciences de l'Informatique (Tunisia)

Narjess Derouiche

> Monitoring of the Anonymous I2P Network
> Date: from Avril 2013 to Sep 2013
> Institution: Ecole supérieure des communications de Tunis (SUP'COM) (Tunisia)

Fadwa Rebhi

> Subject: Development of an automated detection tool of malicious applications in Android-based smartphones
> Date: from Mar 2013 to Sep 2013
> Institution: Ecole Nationale des Sciences de l'Informatique (Tunisia)

Evangelia Tsiontsiou

> Subject: Multi-constrained QoS routing for wireless sensor networks
> Date: from March 2013 to July 2013
> Institution: Université Nationale Capodistrienne d'Athènes (Greece)

Achraf Weslati

> Subject: Co-Simulation applied to Networking, Driving and Pedestrian
> Date: from Mar 2013 to Sep 2013
> Institution: Ecole Nationale des Sciences de l'Informatique (Tunisia)

8.5.1.2. Scientific visits

> **Participant:** Juan Caubet.
> Visiting PhD student
> Subject: A Distributed Authentication System for Content-Centric Networking
> Date: from Aug 2013 to Nov 2013
> Institution: Technical University of Catalonia (UPC) (Spain)

Visiting PhD Student Aug 2013 to Nov 2013

8.5.2. Visits to International Teams

Anthea Mayzaud visited the Jacobs University in Bremen, Germany, during August 2013, more precisely in the Computer Science department led by Jürgen Schönwälder. The purpose of the visit was to define the exact collaboration possible between the two research groups within the area of securing RPL networks by using risk mitigation approaches. A secondary purpose was to get familiar with the Contiki RPL implementation and the tools, such as Cooja, provided by Contiki in order to implement the chosen risk mitigation approach. A joint paper between the research group at Jacobs and Inria on the "Mitigation of RPL DAG Inconsistency Attacks by Dynamically Rate Limiting Local Repair" has been written as a result of this visit.

SCORE Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR ConcoRDanT ANR-10-BLAN-0208 (2010–2014)

Participants: Pascal Urso [contact], Mehdi Ahmed-Nacer, Claudia-Lavinia Ignat, Gérald Oster.

Partners: REGAL project-team (Inria Paris - Rocquencourt / LIP6, coordinator), CITI institute (Universidade Nova de Lisboa, Portugal), GDD team (University of Nantes) and SCORE team.

Website: http://concordant.lip6.fr/

Massive computing systems and their applications suffer from a fundamental tension between scalability and data consistency. Avoiding the synchronisation bottleneck requires highly skilled programmers, makes applications complex and brittle, and is error-prone.

The ConcoRDanT project (oct. 2010 – apr. 2014) investigates a promising new approach that is simple, scales, and provably ensures eventual consistency. A Commutative Replicated Data Type (CRDT) is a data type where all concurrent operations commute. If all replicas execute all operations, they converge; no complex concurrency control is required. We have shown in the past that CRDTs can replace existing techniques in a number of tasks where distributed users can update concurrently, such as co-operative editing, wikis, and version control. However CRDTs are not a universal solution and raise their own issues (e.g., growth of meta-data).

The ConcoRDanT project engages in a systematic and principled study of CRDTs, to discover their power and limitations, both theoretical and practical. Its outcome will be a body of knowledge about CRDTs and a library of CRDT designs, and applications using them. We are hopeful that significant distributed applications can be designed using CRDTs, a radical simplification of software, elegantly reconciling scalability and consistency.

6.1.2. ANR STREAMS ANR-10-SEGI-010 (2010–2014)

Participants: Gérald Oster [coordinator], Luc André, Claudia-Lavinia Ignat, Stéphane Martin, Pascal Urso, Hien Thi Thu Truong.

Partners: SCORE team (coordinator), ASAP project-team (University of Rennes 1 / Inria Rennes - Bretagne Atlantique), CASSIS project-team (Inria Nancy - Grand Est / Nancy University), REGAL project-team (Inria Paris - Rocquencourt / LIP6) and GDD team (University of Nantes / LINA)

Website: http://streams.loria.fr/

The STREAMS project (nov. 2010 – oct. 2013) proposes to design peer-to-peer solutions that offer underlying services required by real-time social web applications and that reduce the disadvantages of centralised architectures. These solutions are meant to replace a central authority-based collaboration with a distributed collaboration that offers support for decentralisation of services.

The STREAMS project aims to advance the state of the art on peer-to-peer networks for social and real-time applications. Scalability is generally considered as an inherent characteristic of peer-to-peer systems. It is traditionally achieved using replication techniques. Unfortunately, the current state of the art in peer-to-peer networks does not address replication of continuously updated content due to real-time user changes. Moreover, there exists a tension between sharing data with friends in a social network deployed in an open peer-to-peer network and ensuring privacy. One of the most challenging issue in social applications is how to balance collaboration with access control to shared objects. Interaction is aimed at making shared objects available to all who need them, whereas access control seeks to ensure this availability only to users with proper authorisation. STREAMS project aims at providing theoretical solutions to these challenges as well as practical experimentations.

6.1.3. ANR Kolflow (2011–2014)

Participant: Gérôme Canals.

Partners: GDD team (University of Nantes / LINA), Loria (Orpailleur and SCORE Teams), Silex Team (LIRIS, University of Lyon), Edelweiss (Inria Project).

Website: http://kolflow.univ-nantes.fr/mediawiki/index.php

Kolflow aims at building a social semantic space where humans collaborate with smart agents in order to produce knowledge understandable by humans and machines. Humans are able to understand the actions of smart agents. Smart agents are able to understand actions of humans. Kolflow targets the co-evolution of content and knowledge as the result of interactions of humans and machines. Our work in the Kolflow project focus on implementing knowledge base testing strategies [23].

6.1.4. FSN OpenPaaS (2012–2015)

Participants: Olivier Perrin, Ahmed Bouchami.

Partners: Samovar team (Telecom SudParis), SCORE team (Université de Lorraine, Loria), ARMINES (Ecole des Mines d'Albi), Brake France, Linagora.

Website: http://www.open-paas.org

The OpenPaaS project aims at developing a PaaS (Platform as a Service) technology dedicated to enterprise collaborative applications deployed on hybrid clouds (private/public). OpenPaaS is a platform that allows to design and deploy applications based on proven technologies provided by partners such as collaborative messaging systems, integration and workflow technologies that will be extended in order to address Cloud Computing requirements. Available as an open-source Enterprise Social Network, the OpenPaaS project innovates both at the collaborative level and by its capacity to leverage heterogeneous cloud technologies at the IaaS level (Infrastructure as a Service). This project is funded under the French FSN umbrella (Fond National pour la société Numérique).

6.2. European Initiatives

6.2.1. FP7 Projects

6.2.1.1. SyncFree FP7-ICT 609551 (2013–2016)

Participants: Pascal Urso [contact], Jordi Martori.

Partners: REGAL project-team (Inria Paris - Rocquencourt / LIP6, coordinator), SCORE team, Trifork A/S (Denmark), Universidade Nova de Lisboa (Portugal), Technische Universität Kaiserslautern (Germany), Basho Technologies (United Kingdom), Rovio Entertainment (Finland), Université Catholique de Louvain (Belgium), Koç Üniversitesi (Turkey)

Website: https://syncfree.lip6.fr/

SyncFree FP7-ICT project brings together academic researchers and industrial practitioners to explore new approaches to data consistency at a massive scale. On-line services including social networks and multi-player games handle huge quantities of frequently changing shared data. Maintaining its consistency is simple in a centralised cloud, but no longer possible due to increased scalability requirements. Instead, data must be replicated across several distributed data centers, requiring new principled approaches.

In this context, SCORE team is interested in designing new and useful replicated data types and in evaluating their performance and behaviour using the massive corpus of real-usage data provided by industrial partners.

6.2.2. Collaborations in European Programs, except FP7

Program: EIT ICT Labs

Project acronym: CityCrowdSource

Project title:

Duration: 12 months 2013 - 2013

Coordinator: Thomas Silverston

Other partners: BMU (Hungary), Imperial College London (UK), SAP (Germany), Cap Digital (France)

Abstract: This activity aims at leveraging the potential of crowd-based applications in urban contexts. Crowd-based data collection in combination with official data will lead to a vastly improved coverage and quality of digital information for urban areas.The added-value of the proposal is in : (1) the three services: trust, privacy and crowd processes modelling that are not present in any crowd-sourcing platform available today, (2) the deployment and of these services on top of different crowd-sourcing platforms and (3) the experimentation of these platforms in real life city scenarios. To this end, the activity combines Test bed, Open Source and Living labs catalysts.

6.3. International Initiatives

6.3.1. Inria Associate Teams

6.3.1.1. USCOAST

Title: User Studies on Trustworthy Collaborative Systems

Inria principal investigator: Claudia-Lavinia Ignat

International Partner:

Wright State University (United States of America) - Department of Psychology - Valerie SHALIN

Duration: 2013 - 2015

See also: http://uscoast.loria.fr/

USCoast has, as main objective, the validation of trustworthy collaborative systems using experimental user studies. This type of validation requires the expertise of both computer scientists that designed the systems and social scientists for conceptualizing and measuring human behaviour in collaborative work. The project focuses on the real-time requirements and trust policies in collaborative editing, resulting in a theory for the effect of real-time constraints in collaborative editing and awareness management for the coordination of work in the presence of conflict and disruption. The project includes also validation of proposed light security mechanisms for decentralised collaboration, based on posted measures of voluntary compliance with data sharing restrictions. We will develop new methods for the cost-effective evaluation of collaborative work to compensate for otherwise unrealistic sample sizes and costly engineering, using game theory to inspire task analogues and simulated users along with human users.

6.4. International Research Visitors

6.4.1. Visits of International Scientists

6.4.1.1. Internships

Meagan Aldridge

Subject: Experimental user studies of real-time collaborative systems

Date: from June 2013 until October 2013

Institution: Wright State University, Department of Psychology, United States of America

6.4.1.2. Invited researchers

Participant: Valerie Shalin.

> Subject: Experimental user studies of real-time collaborative editing and trust-based collaboration
>
> Date: from May 2013 until June 2013 and from October 2013 until May 2014 (sabbatical)
>
> Institution: Wright State University, Department of Psychology, United States of America

Participant: Weihai Yu.

> Subject: Collaborative editing algorithms
>
> Date: from September 2013 until July 2014 (sabbatical)
>
> Institution: University of Tromsø, Department of Computer Science, Norway

ALICE Project-Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

"Contrat région projet émergent" CORIDA (X. Antoine)/ALICE (B. Lévy): budget of 25 K€ shared between both teams.

6.2. National Initiatives

6.2.1. ANR BECASIM (2013 – 2016)

890 K€. X. Antoine heads the second partner, which includes Bruno Lévy. Budget for Nancy: 170 K€ of which 100 K€ are for IECL (team CORIDA). This project is managed by Inria.

6.2.2. ANR Bond (2013 – 2017)

X. Antoine is a member of ANR BOND ("projet blanc").

6.2.3. ANR TECSER

X. Antoine is a member of ANR TECSER that stemmed from the ASTRID program (DGA). The consortium gathers Inria (S. Lantéri, Nice-Sophia, ÉPI CORIDA (X. Antoine) and HIEPACS), EADS, and Nuclétudes.

Total budget: 300 K€ of which 54 K€ are for CORIDA.

6.2.4. ANR Similar-Cities (jeune chercheur)

Sylvain Lefebvre has a continued collaboration with our industrial partners Allegorithmic and the CSTB (Centre Scientifique et Technique du Bâtiment) through the ANR project Similar-Cities. A technological transfer agreement was signed in early 2013 and the project ended on February.

6.2.5. ANR Physigraphix (jeune chercheur)

Rhaleb Zayer has continued the investigations on the ANR project Physigraphix, which aim is to bridge the gap between acquisition and modeling in the context of deformable objects.

6.2.6. ANR Morpho

Dobrina Boltcheva and Bruno Lévy are involved in the ANR project Morpho. Morpho is aimed at designing new technologies for the measure and for the analysis of dynamic surface evolutions using visual data.

6.3. European Initiatives

6.3.1. FP7 Projects

6.3.1.1. GoodShape

Title: Numerical Geometric Abstractions: from bits to equations

Type: IDEAS

Instrument: ERC Starting Grant

Duration: August 2008 – July 2013

Coordinator: Inria

Inria contact: Bruno Lévy

Abstract: GoodShape involves several fundamental aspects of 3D modeling and computer graphics. GoodShape is taking a new approach to the classic, essential problem of sampling, or the digital representation of objects in a computer. This new approach proposes to simultaneously consider the problem of approximating the solution of a partial differential equation and the optimal sampling problem. The proposed approach, based on the theory of numerical optimization, is likely to lead to new algorithms, more efficient than existing methods. Possible applications are envisioned in inverse engineering and oil exploration.

6.3.1.2. ShapeForge

Title: ShapeForge: By-Example Synthesis for Fabrication

Type: IDEAS

Instrument: ERC Starting Grant

Duration: December 2012 – November 2017

Coordinator: Inria

Inria contact: Sylvain Lefebvre

Abstract: Despite the advances in fabrication technologies such as 3D printing, we still lack the software allowing for anyone to easily manipulate and create useful objects. Not many people possess the required skills and time to create elegant designs that conform to precise technical specifications. 'By–example' shape synthesis methods are promising to address this problem: New shapes are automatically synthesized by assembling parts cutout of examples. The underlying assumption is that if parts are stitched along similar areas, the result will be similar in terms of its low–level representation: Any small spatial neighbourhood in the output matches a neighbourhood in the input. However, these approaches offer little control over the global organization of the synthesized shapes, which is randomized. The ShapeForge challenge is to automatically produce new objects visually similar to a set of examples, while ensuring that the generated objects can enforce a specific purpose, such as supporting weight distributed in space, affording for seating space or allowing for light to go through. This properties are crucial for someone designing furniture, lamps, containers, stairs and many of the common objects surrounding us. The originality of our approach is to cast a new view on the problem of 'by–example' shape synthesis, formulating it as the joint optimization of 'by–example' objectives, semantic descriptions of the content, as well as structural and fabrication objectives. Throughout the project, we will consider the full creation pipeline, from modeling to the actual fabrication of objects on a 3D printer. We will test our results on printed parts, verifying that they can be fabricated and exhibit the requested structural properties in terms of stability and resistance.

6.3.1.3. VORPALINE

Title: Vorpaline PoC

Type: IDEAS

Instrument: ERC Proof of Concept

Objectif: development of the Vorpaline software (see above)

Duration: July 2013 – June 2014

Coordinator: Inria

Inria contact: Bruno Lévy.

Abstract: The VORPALINE "Proof-of-Concept" project, funded by the European Research Council, aims at transforming the scientific results stemming from the GoodShape project into a technological component directly transferable to the industry. The funding allowed us to hire an experimented software architect, Thierry Valentin, who created the industrial software architecture and development tools (continuous integration platform, non-regression tests, software quality tools ...). The result of the project is the Vorpaline software (see section 4.1).

6.4. International Initiatives

6.4.1. Participation in Other International Programs

Xavier Antoine started two collaborations:

- E. Lorin et A.D. Bandrauk (University of Carleton, Canada) and CRM, Montréal, on numerical analysis for quantum chemistry.
- W. Bao (National University of Singapore), on numerical methods for simulating Bose-Einstein condensates.

6.5. International Research Visitors

6.5.1. Visits of International Scientists

- Klaus Hildebrandt (*Max-Planck-Institut für Informatik*) visited us and gave a talk on October 22. He was invited by Rhaleb Zayer.
- Frédéric Claux visited us during two days, from IRIT in Toulouse.

6.5.2. Visits to International Teams

Sylvain Lefebvre visited

- Niloy Mitra, University College London.
- Jérôme Darbon, CNRS & UCLA.

Xavier Antoine gave an invited talk at "EMF 2013, The Ninth International Symposium on Electric and Magnetic Fields", Bruges, Belgium, April 2013.

MAGRIT Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

P. F Villard received fundings from the regional council to develop research about realistic simulation of organ dissection. The internship of Nicolas Koenig dealt with this subject and the results will be published in a communication at MMVR 2014.

8.2. National Initiatives

8.2.1. ANR

- ANR ARTIS (2009-2013)
  Participants: M.-O. Berger, M. Loosvelt, P.-F. Villard.
  The main objective of this fundamental research project is to develop inversion tools and to design and implement methods that allow for the production of augmented speech from the speech sound signal alone or with video images of the speaker's face. The Magrit team is especially concerned with the development of procedures allowing for the automatic construction of a speaker's model from various imaging modalities.

- ANR Visac (2009-2013)
  Participants: M.-O. Berger, B. Wrobel-Dautcourt.
  The ANR Visac is about acoustic-visual speech synthesis by bimodal concatenation. The major challenge of this project is to perform speech synthesis with its acoustic and visible components simultaneously. Within this project, the role of the Magrit team is to build a stereovision system able to record synchronized audio-visual sequences at a high frame rate [12].

- ANR IDeaS (2012-2016)
  Participants: R. Anxionnat, M.-O. Berger, E. Kerrien.
  The IDeaS Young Researcher ANR grant explores the potential of Image Driven Simulation (IDS) applied to interventional neuroradiology. IDS recognizes the current, and maybe essential, incapacity of interactive simulations to exactly superimpose onto actual data. Reasons are various: physical models are often inherently approximations of reality, simplifications must be made to reach interactive rates of computation, (bio-)mechanical parameters of the organs and surgical devices cannot but be known with uncertainty, data are noisy. This project investigates filtering techniques to fuse simulated and real data. Magrit team is in particular responsible for image processing and filtering techniques development, as well as validation.

8.2.2. Collaboration with the Shacra team and AEN SOFA

Participants: R. Anxionnat, M.-O. Berger, E. Kerrien, A. Yureidini.
The SOFA-InterMedS large-scale Inria initiative is a research-oriented collaboration across several Inria project-teams, international research groups and clinical partners. Its main objective is to leverage specific competences available in each team to further develop the multidisciplinary field of Medical Simulation research. Our action within the initiative takes place in close collaboration with both Shacra Inria project-team in Lille and the Department of diagnostic and therapeutic interventional neuroradiology of Nancy University Hospital. We aim at providing in-vivo models of the patient's organs, and in particular a precise geometric model of the arterial wall. Such a model is used by Shacra team to simulate the coil deployment within an intracranial aneurysm. The associated medical team in Nancy, and in particular our external collaborator René Anxionnat, is in charge of validating our results. For two years, we have also been collaborating with the Shacra team about real time augmentation of deformable organs

8.2.3. Institut Pascal, Université de Clermont-Ferrand

Participants: F. Sur.

Since June 2012, we have been engaged in a collaboration with Pr. Michel Grédiac. The aim is to give a mathematical analysis and to help improving the image processing tools used in experimental mechanics at Institut Pascal.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

Pierre-Frédéric Villard has a Honorary Research Fellow contract with Imperial College. The collaboration has involved 1 research visit in London in summer to mainly discuss about the writing of a common article [14]. He also participated as an activity leader in two one-week summer schools on Haptic Technology (to give the basics of computer haptics, including visual and haptics rendering, force feedback, haptic interfaces, collision detection, collision response and deformation modeling).

8.4. International Research Visitors

8.4.1. Visits to International Teams

Pierre-Frédéric Villard spent one month at Bangor University as a visiting researcher. This visiting fellowship was supported by the Wales Research Institute for Visual Computing (RIVIC). The aim was to improve existing solutions of respiration models based on optimization-driven models. Four parts have been studied: the meshing method, the deformation method, the boundary condition choice and the optimization method. A M.Sc. student was working on this subject and he has been remotely supervised by Pierre-Frédéric Villard until end of August.

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. AME Satelor SATELOR

Participants: François Charpillet, Maxime Rio, Nicolas Beaufort, Xuan Nguyen, Amandine Dubois.

Economic mobilisation agency in Lorraine has launched a new project SATELOR providing it with 2.5 million Euros of funding over 3 years, out of an estimated total of 4.7 million. The leader of the project is Pharmagest-Diatelic. PHARMAGEST is the French leader in computer systems for pharmacies, with a 43.5 % share of the market, 9,800 clients and more than 700 employees. Pharmagest is in Nancy. Recently, PHARMAGEST Group expanded its activities into e-health and the development of telemedicine applications. The SATELOR project will accompany the partners of the project in developing new services for maintaining safely elderly people with loss of autonomy at home or people with a chronic illness. Maia team will play an important role for bringing some research results such as those presented in section 6.2.2.1 at an industrial level.

8.2. National Initiatives

8.2.1. Inria IPL PAL Personally Assisted Living

Participants: François Charpillet, Olivier Simonin, Mihai Andries.

The PAL project is a national Inria Large Scale Initiative involving several teams of the institute (Arobas, Coprin, E-motion, Lagadic, Demar, Maia, Prima, Pulsar and Trio). It is coordinated by David Daney (Inria Sophia-Antipolis, EPI Coprin). The project focuses on the study and experiment of models for health and well-being. Maia is particularly involved in the People Surveillance work package, by studying and developing intelligent environments and distributed tracking devices for people walking analysis and robotic assistance (smart tiles, 3D camera network, assistant robots), cf. Sec. 6.2.2.1 , 6.2.2.2 and 6.2.1.4 .

The PhD of Mihai Andries in funded by the PAL project.

8.2.2. PIA LAR Living Assistant Robot

Participants: François Charpillet, Abdallah Dib.

Partners : Crédit Agricole, Diatelic, Robosoft
LAR project has the objective to designing an assistant robot to improve the autonomy and quality of life for elderly and fragile persons. The project started at the beginning of the year. The role of the Maia Team is to develop a simultaneous localisation and mapping algorithm using a RGB-D camera. The main issue is to develop an algorithm able to deal with dynamic environment. An other issue is for the robot to be able to behave with acceptable social skills.

8.2.3. Inria ADT Percee (2011-13)

Participants: Olivier Simonin, François Charpillet, Nicolas Beaufort.

Olivier Rochel, from SED, is an external collaborator. Moutie Chaider was hired as an IJD in 2012.

Percee, for "Perception Distribuée pour Environnements Intelligents", is a project proposed by the Maia and Madynes teams and funded by Inria. This ADT (Action de Développement Technologique) supports our action in the PAL Inria National Scale Initiative (Personally Assisted Living, see 8.2.1).

The project deals with the development and the study of intelligent homes. Since two years we have developed an experimental platform, the smart apartment. It allows us to study models and technology for life assistance (walk analysis with iTiles and camera networks, robotic assistants, health diagnostic, domotic functions, wireless communication inside home).

In particular we develop a new tactile floor, which is the iTiles network. Two engineers are funded by the ADT: Moutie Chaider (IJD) and Olivier Rochel (Inria research engineer) for two years.

8.2.4. ANR

8.2.4.1. ANR PHEROTAXIS

Participants: François Charpillet, Olivier Simonin.

Dominique Martinez (Cortex team, Inria NGE) is an external collaborator and the coordinator of the project for Nancy members.

PHEROTAXIS is an "Investissements d'Avenir" ANR 2011-2014 (Coordination: J.-P. Rospars, UMR PISC, INRA Versailles).

The theme of the research is localisation of odour sources by insects and robots. By associating experimental data with models, the project aims at defining a behavioral model of olfactive processes. This work provides several applications, in particular the development of bio-inspired components highly sensitive and selective.

The project is organized in five work packages and involves the PISC research unit (Versailles), Pasteur Institute (Paris) and LORIA/Inria institute (Nancy).

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: InterReg IV B
Project acronym: InTraDE
Project title: Intelligent Transportation for Dynamic Environment
Duration: 2010 - 2014
Coordinator: University of Science and Technology of Lille (Lille 1-LAGIS) (France),
Other partners: South East England Development Agency (United Kingdom), Centre Régional d'Innovation et de Transfert de Technologie – Transport et Logistique (CRITT TL) (France), AG Port of Oostende (AGHO) (Belgium), National Institute for Transport and Logistics, Dublin Institute of Technology (Ireland), Liverpool John Moores University (LOOM) (United Kingdom)
Abstract:

The InTraDE project (Intelligent Transportation for Dynamic Environments, http://www.intrade-nwe.eu/) is funded by the European North West Region. The project is coordinated by Rochdi Merzouki from University of Science and Technology of Lille (LAGIS lab.). Other partners are the Maia team, Liverpool John Moores University (LOOM), the National Institute for Transport and Logistics in Dublin Institute of Technology, the South East England Development Agency, the AGHO Port of Oostende and the CRITT in Le Havre. In the context of seaports and maritime terminals, the InTraDE project aims to improve the traffic management and space optimization inside confined spaces by developing a clean and safe intelligent transportation system. This transportation system will operate in parallel with virtual simulation software of the automated site, allowing a robust and real-time supervision of the goods handling operation.

The Maia team partner focuses on decentralized approaches to deal with the control of automated vehicle platooning and the adaptation of the traffic. Maia is funded with two PhD fellowships and one engineer. Both PhD thesis started in the end of 2010. The PhD of Jano Yazbeck, supervised by F. Charpillet and A. Scheuer, aims at studying a "Secure and robust immaterial hanging for automated vehicles" (see Sec. 6.2.1.1). The PhD of Mohamed Tlig, supervised by O. Simonin and O. Buffet, addresses "Reactive coordination for traffic adaptation in large situated multi-agent systems" (see Sec. 6.2.1.3).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Dr. Iadine Chadès, Research Scientist at CSIRO, Ecosystem Sciences division (Brisbane, Australia), visited MAIA for 1 week in July 2013.

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

8. Partnerships and Cooperations

8.1. International Initiatives

8.1.1. Participation In International Programs

8.1.1.1. Facepe Inria Project: CM2ID
Participants: Amedeo Napoli [contact person], Chedy Raïssi.

This research project called "Combining Numerical and Symbolical Methods for the Classification of Multi-valued and Interval Data (CM2ID)" involves the Orpailleur Team at Inria NGE, AxIS at Inria Rocquencourt (Yves Lechevallier) and the computer science laboratory of the University of Recife (Prof. Francisco de A.T. de Carvalho). The project aims at developing and comparing classification and clustering algorithms for interval and multi-valued data. Two families of algorithms are studied, namely "clustering algorithms" based on the use of a similarity or a distance for comparing the objects, and "classification algorithms in Formal Concept Analysis (FCA)" based on attribute sharing between objects. The objectives here are to combine the facilities of both families of algorithms for improving the potential of each family in dealing with more complex and voluminous datasets.

Finally, a workshop was organized in April 2013 , namely the "French-Brazilian Workshop on Numerical and Symbolic Methods of Data Analysis -WFB2013" (http://www.cin.ufpe.br/~wfb2013/).

8.1.1.2. Fapemig Inria Project: IKMSDM
Participants: Amedeo Napoli [contact person], Chedy Raïssi.

This Fapemig – Inria research project, called "Incorporating knowledge models into scalable data mining algorithms" involves researchers at Universidade Federal de Minas Gerais in Belo Horizonte –a group led by Prof. Wagner Meira– and the Orpailleur team at Inria Nancy Grand Est. In this project we are interested in the mining of large amount of data and we target two relevant application scenarios where such issue may be observed. The first one is text mining, i.e. extracting knowledge from texts and document categorization. The second application scenario is graph mining, i.e. determining relationship-based patterns and use these relations to perform classification tasks. In both cases, the computational complexity is large either because the high dimensionality of the data or the complexity of the patterns to be mined. Loïc Cerf from UFMG visited the Orpailleur team in January 2013 while Chedy Raïssi visited UFMG in May 2013.

8.1.1.3. Pronex Brasilia
Participant: Bernard Maigret [contact person].

In this research project, the goal is to identify, using virtual screening techniques that we developed, new compounds against tropical diseases (e.g. trypanosome, dengue and mycosis) in collaboration with several Brazilian laboratories among which the Department of Biology at University of Brasilia, together with the Harmonic Pharma start-up. Through this collaboration, several PhD and postdocs came to the lab for one year training with our home-developed virtual screening engine (VSM-G). This project is in part supported by the Brazilian CNPq agency. Fruitful results were already obtained leading to several papers in preparation and patents. These patents concern the discovery of new putative treatment of strong mycosis due to fungi particularly virulent in South America. These patents were funded by the University of Brasilia, Embrapa and Harmonic Pharma.

8.1.1.4. International collaborations in Mining complex data
Participants: Mehwish Alam, Aleksey Buzmakov, Melisachew Chekol, Victor Codocedo, Adrien Coulet, Elias Egho, Ioanna Lykourentzou, Amedeo Napoli [contact person], Chedy Raïssi, Jean-Sébastien Sereni, Mario Valencia.

8.1.1.4.1. PICS CNRS CAdOE

A collaboration involves the Orpailleur team, "Université du Québec à Montréal" (UQAM) in Montréal with Prof. Petko Valtchev and Laboratoire LIRMM in Montpellier with Prof. Marianne Huchard. This collaboration is supported by a CNRS PICS project (2011-2014), which is called "Concept Analysis driving Ontology Engineering" and abbreviated in "CAdOE". The research work within this project is aimed at defining and implementing a semi-automatic methodology supporting ontology engineering based on the joint use of Formal Concept Analysis (FCA) and Relational Concept Analysis (RCA). This year the work was mainly focused on RCA and some important papers were published [33], [57].

8.1.1.4.2. Miscellaneous

- An on-going collaboration involves the Orpailleur team and Sergei Kuznetsov at Higher School of Economics in Moscow (HSE). Amedeo Napoli visited HSE laboratory in March 2013 (with the support of HSE) and met Sergei Kuznetsov several times during the year. In addition, Alexey Neznanov from HSE Moscow visited the Orpailleur team in May 2013 while Dmitry Ignatov visited the visited the Orpailleur team in September 2013.

   These visits were the occasion of preparing a publications. Moreover, Sergei Kuznetsov and Amedeo Napoli, together with Claudio Carpineto organized a workshop related to the ECIR Conference in Moscow in March 2013 on "Formal Concept Analysis meets Information Retrieval" (http://www.hse.ru/en/org/hse/fcair).

- A so-called AGAUR Project funded by UPC Barcelona involves Amedeo Napoli and Jaume Baixeries who is an Associate Professor at UPC Barcelona (Universitat Politècnica de Catalunya). Both researchers have worked, jointly with Mehdi Kaytoue, on the characterization of functional dependencies in many-valued data with FCA and pattern structures [38].

- A PHC Zenon project (Cyprus) with Florent Domenach, associated professor at the University of Nicosia in Cyprus was finished at the end of last year. This project was entitled "Knowledge Discovery for Complex Data in Formal and Relational Concept Analysis" (KD4CD) and is aimed at studying and combining different types of classification process in the framework of FCA. As a result of this collaboration, some papers were published this year, among which one at the ICFCA Conference in Dresden [49], [61].

- A PHC Proteus project (Slovenia) with Riste Škrekovski, professor at the University of Ljubljana ended at the end of 2013. This project was entitled "Graphs for combinatorial chemistry and complex networks". Several manuscripts are under submission.

- LEA STRUCO is an "Associated International Laboratory" of CNRS between IÚUK, Prague, and LIAFA, Paris. It focuses on high-level study of fundamental combinatorial objects, with a particular emphasis on comprehending and disseminating the state-of-the-art theories and techniques developed. The obtained insights shall be applied to obtain new results on existing problems as well as to identify directions and questions for future work. Jean-Sébastien Sereni is the contact person for LEA STRUCO which was initiated when Jean-Sébastien was a member of LIAFA.

- At present, Mario Valencia is the international coordinator of the MathAmSud project 13MATH-07 "Structural an algebraic problems on graph theory" (2013–2015). This project is funded by the following research institutes: CNRS in France, MinCyT in Argentina, CAPES in Brazil and CMM in Chile.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. HEREDIA
Participant: Jean-Sébastien Sereni [contact person].

HEREDIA (http://www.liafa.univ-paris-diderot.fr/~sereni/Heredia/) is an ANR JCJC ("Jeunes Chercheurs") focusing on hereditary properties of graphs, which provide a general perspective to study graph properties. Several important general theorems are known and the approach offers an elegant way of unifying notions and proof techniques. Further, hereditary classes of graphs play a central role in graph theory. Besides their theoretical appeal, they are also particularly relevant from an algorithmic point of view. With Jean-Sébastien Sereni, the HEREDIA project involves Pierre Charbit (LIAFA, Paris), Louis Esperet (G-SCOP, Grenoble) and Nicolas Trotignon (LIP, Lyon).

8.2.1.2. Hybride

Participants: Luis-Felipe Melo, Amedeo Napoli, Chedy Raïssi, My Thao Tang, Mohsen Sayed, Yannick Toussaint [contact person].

The Hybride research project (http://hybride.loria.fr/) aims at developing new methods and tools for supporting knowledge discovery from textual data by combining methods from Natural Language Processing (NLP) and Knowledge Discovery in Databases (KDD). A key idea is to design an interacting and convergent process where NLP methods are used for guiding text mining and KDD methods are used for analyzing textual documents. NLP methods are mainly based on text analysis, and extraction of general and temporal information. KDD methods are based on pattern mining, e.g. itemsets and sequences, formal concept analysis and variations, and graph mining. In this way, NLP methods applied to some texts locate "textual information" that can be used by KDD methods as constraints for focusing the mining of textual data. By contrast, KDD methods can extract itemsets or sequences that can be used for guiding information extraction from texts and text analysis. Experimental and validation parts associated with the Hybride project are provided by an application to the documentation of rare diseases in the context of Orphanet.

The partners of the Hybride consortium are the GREYC Caen laboratory (pattern mining, NLP, text mining), the MoDyCo Paris laboratory (NLP, linguistics), the INSERM Paris laboratory (Orphanet, ontology design), and the Orpailleur team at Inria NGE (FCA, knowledge representation, pattern mining, text mining).

8.2.1.3. ISTEX

Participants: Luis-Felipe Melo, Amedeo Napoli, Yannick Toussaint [contact person].

ISTEX is a so-called "Initiative d'excellence" managed by CNRS and DIST ("Direction de l'Information Scientifique et Technique"). ISTEX aims at giving to the research and teaching community an on-line access to scientific publications in all the domains. Thus ISTEX is in concern with a massive acquisition of documentation such as journals, proceedings, corpus, databases...ISTEX-R is one research project within ISTEX in which is involved the Orpailleur team, with two other partners, namely the ATILF laboratory and the INIST Institute (both in Nancy). ISTEX-R aims at developing a new generation of tools for querying full-text documentation, analyzing their content or extracting information and knowledge units. A platform is currently under development to provide robust NLP tools for text processing, as well as methods in text mining and domain conceptualization.

8.2.1.4. Kolflow

Participants: Jean Lieber [contact person], Alice Hermann, Amedeo Napoli, Emmanuel Nauer, My Thao Tang, Yannick Toussaint.

Kolflow (http://kolflow.univ-nantes.fr/) is a 3-year basic research project taking place from February 2011 to July 2014, funded by French National Agency for Research (ANR), program ANR CONTINT. The aim of the project is investigation on man-machine collaboration in continuous knowledge-construction flows.

Kolflow partners are GDD (LINA Nantes), Silex (LIRIS Lyon), Orpailleur (Inria NGE/LORIA), Score (Inria NGE/LORIA), and Wimmics (Inria Sophia Antipolis).

8.2.1.5. PEPSI: Polynomial Expansions of Protein Structures and Interactions

Participants: David Ritchie, Marie-Dominique Devignes, Malika Smaïl-Tabbone.

The PEPSI ("Polynomial Expansions of Protein Structures and Interactions") project is a collaboration with Sergei Grudinin at Inria Grenoble (project Nano-D) and Valentin Gordeliy at the Institut de Biologie Structurale (IBS) in Grenoble. This four-year project funded by the ANR "Modèles Numériques" program involves developing computational protein modeling and docking techniques and using them to help solve the structures of large molecular systems experimentally (http://pepsi.gforge.inria.fr).

8.2.1.6. Termith

Participants: Luis-Felipe Melo, Yannick Toussaint [contact person].

Termith (http://www.atilf.fr/ressources/termith/) is an ANR Project which involves the following laboratories: ATILF, LIDILEM, LINA, INIST, Inria Saclay and Inria Nancy Grand Est. It aims at indexing documents belonging to different domain of Humanities. Thus, the project focuses on extracting term candidates (information extraction) and on disambiguation.

In the Orpailleur team, we are mainly concerned by information extraction using Formal Concept Analysis techniques, but also itemset or sequence extraction. The objective is to define "contexts introducing terms", i.e. finding textual environments allowing a system to decide whether a textual element is actually a term and its corresponding domain.

8.2.1.7. Trajcan: a study of patient care trajectories

Participants: Elias Egho, Nicolas Jay [contact person], Amedeo Napoli, Chedy Raïssi.

Since 30 years, many patient classification systems (PCS) have been developed. These systems aim at classifying care episodes into groups according to different patient characteristics. In France, the so-called "Programme de Médicalisation des Systèmes d'Information" (PMSI) is a national wide PCS in use in every hospital. It systematically collects data about millions of hospitalizations. Though it is used for funding purposes, it includes useful information for public health domains such as epidemiology or health care planning.

The objective of the Trajcan project is to represent and analyze "patient care trajectories" (patient suffering from cancer limited to breast, colon, rectum, and lung cancers) and the associated healthcares. The data are related to patients receiving hospital cares in the "Bourgogne" region and using data from the PMSI. Such an analysis involves various data, e.g. type of cancer, number of visits, type of stays, hospitalization services and therapies used, and demographic factors, i.e. age, gender, place of residence.

One thesis is currently carried out on this subject whose objective is to design a knowledge discovery system working on multidimensional and sequential data for characterizing Patient Care Trajectories (PCT) [52], [62]. This thesis combines knowledge discovery and knowledge representation methods for improving the definition of patient care trajectories as temporal objects (sequential data mining). The overall objective is to improve decision support and healthcare in detecting for example typical or exceptional trajectories for planning with precision healthcare for a given population.

In parallel, Formal Concept Analysis techniques were used in conjunction with regression tree analysis to produce semi-automated classification of PCTs in the field of breast cancer in France [27].

8.2.2. Other National Initiatives and Collaborations

8.2.2.1. PEPS Cryo-CA

Participant: David Ritchie [Inria Nancy].

Cryo-CA is a two-year PEPS project ("Projets exploratoires pluridisciplinaires") funded by CNRS, involving a collaboration with cryo-electron microscopy experimentalists at the IGBMC ("Institut de Génétique et de Biologie Moléculaire et Cellulaire") in Strasbourg. People involved in the project with David Ritchie are Sergei Grudinin (Inria Grenoble), Annick Dejaegere (IGBMC, Strasbourg), and Patrick Schultz (IGBMC Strasbourg). The aim of the project is to encourage collaborations between experimentalists and computer scientists in order to advance the state of the art of computational algorithms in structural biology.

8.2.2.2. Towards the discovery of new nonribosomal peptides and synthetases

We have initiated a collaboration with researchers from the LIFL and Université Lille Nord de France. We collaborated on the NRPS toolbox [109]. Data was cleaned and integrated from various public and specific analysis programs. The resulting database should facilitate the process of knowledge discovery of new nonribosomal peptides and synthetases.

8.3. Regional Initiatives

8.3.1. *Le Bois Santé (LBS)*

Participants: Emmanuel Bresso, Marie-Dominique Devignes [contact person], Malika Smaïl-Tabbone.

The project "LBS – Le Bois Santé – #38017" is funded by the European Regional Development Fund (FEDER) and the French "Fonds Unique Interministériel (FUI)" in the framework of the BioProLor consortium. This project is coordinated by "Harmonic Pharma", a start-up specialized in the identification of active principles in natural products. The aim of LBS is to exploit wood products in the pharmaceutical and nutriment domains. Concerned people in the team are working on data management and knowledge discovery about new therapeutic applications.

The BioProLor consortium is composed of 5 enterprises and 7 academic research teams, which were funded for 3 years (2010–2013) by AME ("Agence pour la Mobilisation Economique") for the design of compounds with high added-value which originate from plants in Lorraine. Finally, it should be noticed that the PhD Thesis work of Emmanuel Bresso was taken in charge by Harmonic Pharma (CIFRE contract, 2009-2013).

8.3.2. *PEPS Mirabelle EXPLOD-Biomed*

Participants: Adrien Coulet, Marie-Dominique Devignes [contact person], Gabin Personeni, Malika Smaïl-Tabbone.

This project initiates a collaboration with geneticists from the Hospital of Nancy, namely Philippe Jonveaux and Céline Bonnet. The aim of the EXPLOD-Biomed project is to propose novel knowledge discovery methods applied to Linked Open Data for discovering gene that could be responsible for intellectual deficiencies. Linked Open Data are available on-line, interconnected and encoded in a format which can be straightforwardly mapped to ontologies. Thus they offer novel opportunities for knowledge discovery in biomedical data. Here, geneticists are playing the role of experts, guiding the different steps of the knowledge discovery process.

8.3.3. *Hydreos*

Participant: Jean-François Mari [contact person].

The research project Hydreos (http://www.hydreos.fr/fr) is aimed at evaluating the quality of water. Actually, water resources relies on many agronomic variables, including land use successions. Accordingly, one objective of this research project is to have a better understanding of the changes in the organization of a territory. The data to be analyzed are obtained by surveys or by satellite images and describe the land use at the level of the agricultural parcel. Then there is a search for detecting changes in land use and for correlating these changes to groundwater quality.

The systems ARPEnTAge (see § 5.2.2) and CarottAge (see § 5.2.1) are used in this context, especially by agronomists of INRA (ASTER Mirecourt http://www6.nancy.inra.fr/sad-aster and UMR Costel Rennes http://www.univ-rennes2.fr/costel). In addition, we participated in various meetings of researchers involved in the study of quality of groundwater in Alsace-Lorraine.

This year, or research work focused on collecting and preprocessing satellite data sampled in a territory in Brittany where there is an important phytoplanktonic biomass and Ulva species mass proliferation risk.

8.3.4. Contrat Plan État Région” (CPER)

The links between the Regional Administration and LORIA are materialized through the so-called “Contrat Plan État Région” (CPER) which is running from 2007 to 2013. The associated scientific program is called “Modélisations, informations et systèmes numériques” (MISN) and includes two tracks in which the Orpailleur team is involved.

- “Modeling Bio-molecules and their Interactions” (MBI).

  The general objective of this project is to study how domain knowledge can be taken into account for improving the modeling of biomolecules and their interactions, and the modeling of biological systems (http://bioinfo.loria.fr). Six scientific projects are currently under development and involve collaborations with computer scientists and people working either in biology or chemistry. This project is coordinated by Marie-Dominique Devignes.

- An Inria experimental research platform is currently developed in the framework of MBI (http://bioinfo.loria.fr/Plateforme%20MBI), which is aimed at sharing data and computing resources. The specific features of this platform are relative to biomolecules modeling, to classification and to data integration for data mining. The platform is a constituent of the North-East node of RENABI –“Réseau National des Plateformes Bioinformatiques”– together with the platforms in Strasbourg, Reims, Lille, and Nancy-INIST.

- “Traitement Automatique des Langues et des Connaissances” (TALC).

  TALC stands for “Automatic Processing of Languages and Knowledge”. The general objective of TALC is to study the relations existing between knowledge discovery, knowledge representation, reasoning, and natural language processing. In the framework of TALC, the Orpailleur team plays an important role as the research themes of the team are closely related to those of TALC. Actually, research projects are currently under development on knowledge management and decision support involving in particular the Kasimir and the Taaable systems.

PAROLE Project-Team

8. Partnerships and Cooperations

8.1. National initiatives

8.1.1. Equipex ORTOLANG

Project acronym: ORTOLANG [3]

Project title: Open Resources and TOols for LANGuage

Duration: September 2012 - May 2016 (phase I, signed in January 2013)

Coordinator: ATILF (Nancy)

Other partners: LPL (Aix en Provence), LORIA (Nancy), Modyco (Paris), LLL (Orléans), INIST (Nancy)

Abstract: The aim of ORTOLANG (Open Resources and TOols for LANGuage) is to propose a network infrastructure offering a repository of language data (corpora, lexicons, dictionaries, etc) and tools and their treatment that are readily available and well-documented which will:

- enable a real mutualization of analysis research, of modeling and automatic treatment of our language bringing us up to the best international level;
- facilitate the use and transfer of resources and tools set up within public laboratories towards industrial partners, in particular towards SME which cannot often develop such resources and tools for language treatment due to the costs of their realization;
- promote the French language and local languages of France by sharing knowledge which has been acquired by public laboratories.

Several teams of the LORIA laboratory contribute to this Equipex, mainly with respect to providing tools for speech and language processing, such as text-speech alignment, speech visualization, syntactic parsing and annotation, ...

8.1.2. ANR ARTIS

Project acronym: ARTIS

Project title: Inversion articulatoire de la parole audiovisuelle pour la parole augmentée

Duration: January 2009 - June 2013

Coordinator: Yves Laprie (LORIA)

Other partners: Gipsa-Lab, LTCI, IRIT

Abstract: The main objective of ARTIS is to recover the temporal evolution of the vocal tract shape from the acoustic signal.

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

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[3] http://www.ortolang.fr

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

This year, the project focused on the articulatory synthesis in order to generate better sequences of consonant/vowel/consonant by developing time patterns coordinating source and vocal tract dynamics.

8.1.3. *ANR ViSAC*

> Project acronym: VISAC
>
> Project title: Acoustic-Visual Speech Synthesis by Bimodal Unit Concatenation
>
> Duration: January 2009 - June 2013
>
> Coordinator: Slim Ouni
>
> Other partners: Magrit EPI (Inria)
>
> Abstract: The main VISAC objective is to realize the bimodal (audio plus visual) synthesis of speech.

This contract started in January 2009 in collaboration with Magrit Inria team. The purpose of this project is to develop synthesis techniques where speech is considered as a bimodal signal with its acoustic and visual components that are considered simultaneously. This is done by concatenating bimodal diphone units, that is, units that comprise both acoustic and visual information. The latter is acquired using a stereovision technique. The proposed method addresses the problems of asynchrony and incoherence inherent in classic approaches to audiovisual synthesis. Unit selection is based on classic target and join costs from acoustic-only synthesis, which are augmented with a visual join cost. This final year of the project, we have performed an extensive evaluation of the synthesis system using perceptual and subjective evaluations. The overall outcome of the evaluation indicates that the proposed bimodal acoustic-visual synthesis technique provides intelligible speech in both acoustic and visual channels [22].

8.1.4. *ANR ORFEO*

> Project acronym: ORFEO [4]
>
> Project title: Outils et Ressources pour le Français Ecrit et Oral
>
> Duration: February 2013 - February 2016
>
> Coordinator: Jeanne-Marie DEBAISIEUX (Université Paris 3)
>
> Other partners: ATILF, CLLE-ERSS, ICAR, LIF, LORIA, LATTICE, MoDyCo
>
> Abstract: The main ORFEO objective is the constitution of a Corpus for the Study of Contemporary French.

In this project, we have provided an automatic alignment at the word and phoneme levels for audio files from the corpus TCOF (Traitement de Corpus Oraux en Français). This corpus contains mainly spontaneous speech, recorded under various conditions with a large SNR range and a lot of overlapping speech. We tested different acoustic models and different adaptation methods for the forced alignment.

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[4] http://www.agence-nationale-recherche.fr/en/anr-funded-project/?tx_lwmsuivibilan_pi2[CODE]=ANR-12-CORP-0005

8.1.5. ANR-DFG IFCASL

Project acronym: IFCASL

Project title: Individualized feedback in computer-assisted spoken language learning

Duration: March 2013 - February 2016

Coordinator: Jürgen Trouvain (Saarland University)

Other partners: Saarland University (COLI department)

Abstract: The main objective of IFCASL is to investigate learning of oral French by German speakers, and oral German by French speakers at the phonetic level.

The work has mainly focused on the design of a corpus of French sentences and text that will be recorded by German speakers learning French, recoding a corpus of German sentences read by French speakers, and tools for annotating French and German corpora. Beforehand, two preliminary small corpora have been designed and recorded in order to bring to the fore the most interesting phonetic issues to be investigated in the project. In addition this preliminary work was used to test the recording devices so as to guarantee the same quality of recording in Saarbrücken and in Nancy, and to design and develop recording software.

In this project, we also provided an automatic alignment procedure at the word and phoneme levels for 4 corpora: French sentences uttered by French speakers, French sentences uttered by German speakers, German sentences uttered by French speakers, German sentences uttered by German speakers.

8.1.6. ANR ContNomina

Project acronym: ContNomina

Project title: Exploitation of context for proper names recognition in the diachronic audio documents

Duration: February 2013 - July 2016

Coordinator: Irina Illina (Loria)

Other partners: LIA, Synalp

Abstract: the project ContNomina focuses on the problem of proper names in automatic audio processing systems by exploiting in the most efficient way the context of the processed documents. To do this, the project will address:

- the statistical modeling of contexts and of relationships between contexts and proper names;
- the contextualization of the recognition module through the dynamic adjustment of the lexicon and of the language model in order to make them more accurate and certainly more relevant in terms of lexical coverage, particularly with respect to proper names;
- the detection of proper names, on the one hand, in text documents for building lists of proper names, and on the other hand, in the output of the recognition system to identify spoken proper names in the audio / video data.

8.1.7. FUI RAPSODIE

Project acronym: RAPSODIE [5]

Project title: Automatic Speech Recognition for Hard of Hearing or Handicapped People

Duration: March 2012 - February 2016 (signed in December 2012)

Coordinator: eRocca (Mieussy, Haute-Savoie)

Other partners: CEA (Grenoble), Inria (Nancy), CASTORAMA (France)

Abstract: The goal of the project is to realize a portable device that will help a hard of hearing person to communicate with other people. To achieve this goal the portable device will embed a speech recognition system, adapted to this task. Another application of the device will be environment vocal control for handicapped persons.

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[5] http://erocca.com/rapsodie

In this project, the parole team is involved for optimizing the speech recognition models for the envisaged task, and contributes also to finding the best way of presenting the speech recognition results in order to maximize the communication efficiency between the hard of hearing person and the speaking person.

8.1.8. ADT FASST

The Action de Développement Technologique Inria (ADT) FASST (2012–2014) is conducted by PAROLE in collaboration with the teams PANAMA and TEXMEX of Inria Rennes. It aims to reimplemented into efficient C++ code the Flexible Audio Source Separation Toolbox (FASST) originally developed in Matlab by A. Ozerov, E. Vincent and F. Bimbot in the METISS team of Inria Rennes. This will enable the application of FASST on larger data sets, and its use by a larger audience. The new C++ version will be released early 2014. The second year of the project will be devoted to the integration of FASST with speech recognition software in order to perform noise robust speech recognition.

8.1.9. ADT VisArtico

The technological Development Action (ADT) Inria Visartico just started this November (11/2013 - 10/2015). The purpose of this project is to develop and improve VisArtico, an articulatory vizualisation software. In addition to improve the basic functionalities, several articulatory analysis and processing will be integrated. We will also work on the integration of multimodal data.

8.2. European initiatives

8.2.1. Collaborations in European Programs, except FP7

8.2.1.1. Interreg Allegro

Program: Interreg
Project acronym: Allegro
Project title: Adaptive Language LEarning technology for the Greater Region
Duration: 01/01/2009 to 31/12/2012
Coordinator: Saarland University
Other partners: Supélec Metz and DFK Kaiserslautern
Abstract: Allegro is an Interreg project (in cooperation with the Department of COmputational LInguistics and Phonetics of the Saarland University and Supélec Metz) which started in April 2010. It is intended to develop software for foreign language learning. Our contribution consists of developing tools to help learners to master the prosody of a foreign language, i.e. the prosody of English by French learners, and then prosody of French by German learners. We started by recording (with the project Intonale) and segmenting of a corpus made up of English sentences uttered by French speakers and we analyzed specific problems encountered by French speakers when speaking English. The corrections were implemented in Jsnoori. The final review was held on May 15 in Saarbrücken.

8.2.1.2. Eureka - Eurostars i3DMusic

Besides the above contracts of which PAROLE is officially part, E. Vincent is responsible for his former team (PANAMA) of the following project.

Program: Eureka - Eurostars
Project acronym: i3DMusic
Project title: Real-time Interactive 3D Rendering of Musical Recordings
Duration: 01/10/2010 to 31/03/2014
Coordinator: Audionamix (FR)
Other partners: EPFL (CH), Sonic Emotion (CH)
Abstract: The i3DMusic project aims to enable 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. PANAMA 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. Declared Inria international partners

E. Vincent is involved as an associate member in the national Japanese JSPS Grant-in-Aid for Scientific Research project on distributed microphone arrays led by Nobutaka Ono from the National Institute of Informatics together with other partners from the University of Tsukuba and Tokyo Institute of Technology.

8.4. International research visitors

8.4.1. Visits of international scientists

- Mouhcin, Chami, INPT, Maroco, June,
- Karima Meftouh, Annaba University, until October,
- Amar Djeradi, USTHB, July, Algeria

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SÉMAGRAMME Project-Team

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7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. SLAM: Schizophrenia and Language, Analysis and Modeling

Participants: Maxime Amblard [coordinator], Philippe de Groote, Sylvain Pogodalla, Karën Fort.

Schizophrenia is well-known among mental illnesses for the strength of the thought disorders it involves, and for their widespread and spectacular manifestations: from deviant social behavior to delusion, not to speak about affective and sensitive distortions. It aims at exploring a specific manifestation, namely disorders in conversational speech. This is an interdisciplinary research, both empirical and theoretical from several domains, namely psychology, philosophy, linguistic and computer science.

The SLAMproject started from 2013 January for three years at the Maison des Sciences de l'Homme de Lorraine (MSH–Lorraine, USR 3261). While this year work was dedicated to the test protocol definition, the coming years will be devoted to building an open-access corpus of pathological uses of language.

This year, the first transcriptions of pathological interviews are analyses. The management chain was implemented for anonymization. Moreover, we use Distagger (Matthieu Constant and Anne Dister) to tag disfluences in the interviews wich give interesting results. We also use Jsafran (Christophe Cerisara) and FRMG (Eric de la Clergerie) in order to have dependencies.

Other participants are: Denis Apotheloz (ATILF, Université de Lorraine),Valérie Aucouturier (Centre Léo Apostel, Université Libre de Bruxelles), Katarina Bartkova (ATILF, Université de Lorraine), Fethi Bretel (CHS Le Rouvray, Rouen), Michel Musiol (InterPSY, Université de Lorraine), Manuel Rebuschi (Archives Poincaré, Université de Lorraine).

The SLAMproject was supported by the MSH–Lorraine, USR 3261, and won a one year PEPS project HuMaIn (mission pour l'interdisciplinarité du CNRS). The CNRS part of the budget help to organize a workshop which gather linguists, psychologists and computer scientists in december : http://webloria.loria.fr/~amblard/SLAM/index.php?n=Main.In-coh%E9rence13

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. Polymnie: Parsing and synthesis with abstract categorial grammars. From lexicon to discourse
Participants: Maxime Amblard, Philippe de Groote, Aleksandre Maskharashvili, Sylvain Pogodalla [coordinator], Sai Qian.

POLYMNIE[4] is a research project funded by the French national research agency (ANR). It relies on the grammatical framework of Abstract Categorial Grammars (ACG). A feature of this formalism is to provide the same mathematical perspective both on the surface forms and on the more abstract forms the latter correspond to. As a consequence:

- ACG allows for the encoding of a large variety of grammatical formalisms such as context-free grammars, Tree Adjoining grammars (TAG), etc.
- ACG define two languages: an abstract language for the abstract forms, and an object language for the surface forms.

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[4]http://semagramme.loria.fr/doku.php?id=projects:polymnie

Importantly, the notions of object language and abstract language are relative to each other. If we can naturally see surface forms as strings for instance and abstract forms as the associated syntactic trees, we can also consider to associate this abstract form to a first order logical formula as surface (object) form. This property it central in our project as it offers a unified approach to text analysis and text generation, in particular considering the underlying algorithms and their complexity.

ACG definition uses type-theory and lambda-calculus. From this point of view, they smoothly integrate formal semantics models issuing from Montague's proposal. Theories that extend to the discourse level such as Discourse Representation Theory (DRT) and Dynamic Predicate Logic (DPL) were not initially formulated using lambda-calculus. But such formulation have been proposed. In particular, a formulation based on continuation semantics allow them to be expressed quite naturally in the ACG architecture. Dynamic effects of discourse, in particular those related to anaphora resultion or rhetoretical relation inference, have then to be expressed by lexical semantics or computed from the syntactic rules as studied in the Inria Collaborative Research Project (ARC) CAuLD [5].

It has been shown that the discourse structure of texts plays a key role in their understanding. This is the case for both human readers and automatic processing systems. For instance, it can enhance text transformation systems such as the ones performing automatic summarization.

POLYMNIEfocuses on studying and implementing the modeling of sentences and discourses in a compositional paradigm that takes into account their dynamics and their structures, both in parsing and in generation. To that end, we rely on the ACG framework. The kind of processing we are interested in relate to the automatic construction of summaries or to text simplification. This has to be considered in the limits of the modelling of the linguistic processes (as opposed to inferential processes for instance) these tasks involve.

The complexity of the phenomena, of their formal description, and of their interactions, require to set up a testing and development environment for linguistic modelling. It will consist in extending and stabilizing a software implementing the functionnalities of the ACG framework. It will provide a tool for experimentation and validation of the approach.

Partners:

- Sémagramme people,
- Alpage (Paris 7 university & Inria Paris-Rocquencourt): Laurence Danlos (local coordinator), C. Braud, C. Roze, Éric Villemonte de la Clergerie,
- MELODI (IRIT, CNRS): Stergos Afantenos, Nicholas Asher (local coordinator), Juliette Conrath, Philippe Muller,
- Signes (LaBRI, CNRS): Jérôme Kirman, Richard Moot, Christian Retoré (local coordinator), Sylvain Salvati, Noémie-Fleur Sandillon-Rezer.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

7.3.1.1. Internships

- Ahmed Abbache (Université Hassiba Benbouali, Algeria) did a 5 month internship in the Sémagramme team. He has been working on a formalization of the neokhalilian theory using ACGs.

7.3.2. Visits to International Teams

- Philippe de Groote, Aleksandre Maskharashvili, and Sylvain Pogodalla visited Pr. Makoto Kanazawa at NII, Tokyo, Japan, Oct. 21-25 2013.
- Philippe de Groote gave an invited talk at the Center for Logic and Philosophy of Science of the Tilburg University, on the occasion of Reinhard Muskens' 60th birthday.

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[5]http://www.loria.fr/~pogodall/cauld/