Activity Report 2012

Section Partnerships and Cooperations

<div style="text-align:center; color:red">

CAMUS Team

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7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. *Action d'Envergure Nationale*

Philippe Clauss, Alain Ketterlin and Vincent Loechner are involved in the proposition of an Inria Large Scale Initiative (*Action d'Envergure Nationale*) entitled "Large scale multicore virtualization for performance scaling and portability" and regrouping several french researchers in compilers, parallel computing and program optimization. Philippe Clauss shares the head of the project with Gilles Muller of the Inria REGAL team. The project should start officially early 2013. Philippe Clauss and Erven Rohou (ALF team) will co-advise a PhD thesis on dynamic binary code analysis, parallelization and optimization in the frame of this project.

7.2. International Initiatives

7.2.1. *Inria Associate Teams*

7.2.1.1. 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 - Sergio Yovine

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.

7.2.2. *Participation In International Programs*

The collaboration between the LaFhis team of the University of Buenos Aires and the CAMUS team has also been supported by the CNRS-MINCyt project QUATRIX since 2011.

The CAMUS team is associated to the CNRS-CONICET Associated International Laboratory France-Argentina INFINIS (INformatique Fondamentale, logIque, laNgages, vérIfication et Systèmes) inaugurated in December 2011.

7.3. International Research Visitors

7.3.1. *Visits of International Scientists*

Rachid Seghir, assistant professor at University of Batna (Algeria), was invited in our team from May 10 to 26, 2012. We worked on improving `ZPolyTrans`, our library for computing integer affine images of $\mathbb{Z}$-polyhedra. More precisely, we have implemented non-regression tests and we improved the performance of the library by reducing the complexity of some algorithms. Our major publication on this topic was published in 2012 in ACM TACO [15].

Diego Garbervetsky, University of Buenos Aires, Argentina, has spent two weeks of October 2012 in the CAMUS team.

7.3.1.1. Internships

Juan Manuel Martinez Caamaño, who is Master student at the University of Buenos Aires, is doing his Master thesis internship in the CAMUS team from August 2012 to January 2013.

Gervasio Perez, PhD student at the University of Buenos Aires, Argentina, has spent one month in the CAMUS team in November 2012.

7.3.2. Visits to International Teams

Philippe Clauss visited the parallel computing research team of the University of Tunis, Tunisia, from November the 26th to the 30th. The main goal of the visit was to meet the student Imèn Fassi and her co-advisor Yosr Slama to work for the starting co-advised PhD thesis.

Alain Ketterlin has spent three weeks in the LAFHIS team in January 2012.

Philippe Clauss has spent one week in the LAFHIS team in December 2012.

CARAMEL Project-Team

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, Vlad-Cristian Miclea, 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.

The funding obtained was used to buy an FPGA ML-605 development board, on which Vlad-Cristian Miclea implemented operators for polynomial arithmetic in characteristic two and three during his internship; along with a GeForce GTX 580 graphics card, on which Hamza Jeljeli developed a GPU-based implementation of sparse linear algebra routines for solving discrete-logarithm problems [16].

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: Răzvan Bărbulescu, 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 is scheduled to start in January 2013, but the kick-off meeting has already taken place in Nancy on Dec. 14th, 2012.

8.2.2. *ANR CHIC (Courbes Hyperelliptiques, Isogénies, Comptage)*

Participants: Pierrick Gaudry, Sorina Ionica, Emmanuel Thomé [contact].

The team has obtained a financial support from the ANR ("programme blanc") for a project, common with colleagues from IRMAR (Rennes) and IML (Marseille). The ANR CHIC grant covers the period 09/2009 to 08/2012, and has thus ended in 2012. The purpose of this ANR project is the study of several aspects of curves in genus 2, with a very strong focus on the computation of explicit isogenies between Jacobians.

In 2012, within the context of ANR CHIC, Ionica and Thomé worked on isogeny graphs in genus 2.

8.2.3. *ANR DEMOTIS (Collaborative Analysis, Evaluation and Modelling of Health Information Technology)*

Participant: Marion Videau.

The project from "programme ARPEGE" involved three Inria project-teams as a single partner (SMIS, SECRET and CARAMEL) together with colleagues from CECOJI (CNRS) and the company Sopinspace. It has been running from January 2009 and ended in March 2012.

The project experimented new methods for the multidisciplinary design of large information systems that have to take into account legal, social and technical constraints. Its main field of application is personal health information systems.

8.3. European Initiatives

8.3.1. PHC application with EPFL

The team obtained a PHC Germaine de Staël grant in collaboration with the LACAL team from EPFL (Lausanne, Switzerland), in 2011. The grant has been renewed for a second (and final) year 2012. This collaboration focuses on integer factorization and discrete logarithms.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

Vlad-Cristian MICLEA (from Jun 2012 until Sep 2012)

Subject: Efficient FPGA implementation of finite-field multiplication algorithms

Institution: The Technical University of Cluj-Napoca (Romania)

CARTE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- Emmanuel Jeandel is a member of ANR Blanche ANR-09-BLAN-0164 (EMC: *Emerging Phenomena in Computation Models*).
- We obtained an ANR project called Binsec which will start in 2013. The aim of the BINSEC project 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. We target two main applicative domains: vulnerability analysis and virus detection. Two other closely related applications will also be investigated: crash analysis and program deobfuscation.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. FI-WARE

Title: Morphus

Type: COOPERATION (ICT)

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

Instrument: Integrated Project (IP)

Duration: September 2011 - May 2014

Coordinator: Telefonica (Spain)

Others partners:Thales, SAP, Inria

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 for building a true foundation for the Future Internet.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. CRISTAL

Title: Resource Control by Semantic Interpretations and Linear Proof Theory

Inria principal investigator: Romain Péchoux

International Partner (Institution - Laboratory - Researcher):

     Universita degli Studi di Torino (Italy) - Dipartimento di informatica

Duration: 2010 - 2012

See also: http://carte.loria.fr/index.php?option=com_content&view=article&id=61&Itemid=75

Topic: resource control using semantics interpretations and linear proof theory.

8.3.2. Participation In International Programs

Mathieu Hoyrup is the principal investigator of a Partenariat Hubert Curien Imhotep 2011-2012 together with Walid Gooma, University of Alexandria, Egypt.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Daniel Leivant: October 25th to November 5th, 2012, Indiana University, USA.

Walid Gooma: December, 2012, University of Alexandria, Egypt.

8.4.2. Visits to International Teams

Guillaume Bonfante: July 7th to 15th, 2012, invited by Stanislas Leibler from the 'Institute of Advanced Studies', Princeton, USA. He gave a course on computer virology at the summer school "PiTP", Prospects in Theoretical Physics http://www.sns.ias.edu/pitp2/index.html

Jean-Yves Marion: October 25th to November 5th, 2012, Indiana University, USA, work with Daniel Leivant.

Romain Péchoux: February and August 2012, University of Pennsylvania, USA, invited talk to the PLclub seminar.

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 DECERT — *Deduction and Certification*, coordinated by Thomas Jensen (IRISA). This project focuses on the design of decision procedures, in particular for fragments of arithmetic, and their integration into larger verification systems, including skeptical proof assistants. Partners are: IRISA Rennes, LRI Orsay, Inria Sophia, Systerel and CEA. From Inria Nancy, the teams Veridis and Cassis are involved. This project started in January 2009 for three years.

- ANR TASCCC *Test Automatique basé sur des Scenarios et Critères Communs – Automated Testing based on Scenarios and Common Criteria*, duration: 3 years, starting in December 2009. The project aims at completing the model-based testing process initiated in the POSE project, using scenarios to specify the test cases that have to be generated by model animation. The goal is here to provide an automated means for generating the scenarios from a given set of properties. The overall objective is to ease the Common Criteria evaluation of secure softwares. Partners: Trusted Labs (leader), Gemalto, LIG, LIFC, Supelec, Smartesting, and Serma Technologies. The local coordinator is Frédéric Dadeau.

- 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 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, starting in December 2011. The goal of this project is to test the security with online and offline model-based testing approach. The main element of project is to capitalize or to reuse a test model with different testing method. So, we develop new algorithms to allow online testing. This approach must be compatible with our previous offline approach to increase the number of artefacts that can be shared. This approach can be applied to the components of security and the Software Radio. Partners are 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. Partners are 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) [4]— 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.
- SecureChange[5] is funded under the 7th FP (Seventh Framework Program) Research area: ICT-2007.8.6: ICT forever yours. The project will develop processes and tools that support design techniques for evolution, testing, verification, re-configuration and local analysis of evolving software. Our focus is on mobile devices and homes, which offer both great research challenges and long-term business opportunities. The project is lead by Fabio Massacci (University of Trento, Italy) and it has started in February 2009 for a period of 36 months. Cassis is leader of the 7th workpackage (Testing). The local coordinator is Fabrice Bouquet.

8.4. International Initiatives

8.4.1. Inria Associate Teams

BANANAS[6]*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,

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[4] http://www.loria.fr/~cortier/ProSecure.html
[5] http://www.securechange.eu
[6] http://www.loria.fr/~ringeiss/CHILI/bananas

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.

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.

8.5. International Research Visitors

8.5.1. *Visits of International Scientists*

- Jan Otop (Wroclaw University), one month in March 2012
- Markulf Kohlweiss (Microsoft Cambridge), one week in April 2012
- Bogdan Warinshi (Bristol University), one week in May 2012
- Myrto Arapinis (University of Birmingham), three weeks in July 2012
- Mark Ryan (University of Birmingham), one week in July 2012
- Serdar Erbatur (SUNY Albany), two months in October–November 2012
- John Mullins (Ecole Polytechnique de Montréal), one week, February 2012.
- Hanifa Boucheneb, (Ecole Polytechnique de Montréal), one month in March 2012

8.5.1.1. *Internships*

- Aurel Josias Randolph (from Apr 2012 until May 2012)
  - Subject: Specifying and verifying access control policies for collaborative editors
  - Institution: Polytechnic School of Montreal (Canada)

- Ghazi Maatoug (from Mar 2012 until Jul 2012)
  - Subject: Verification of protocols, analysis of symbolic trace and simulated execution
  - Institution: Ecole Supérieure des Communications de Tunis (Tunisia)

- Apoorva Desphande (from Jul 2012 until Nov 2012)
  - Subject: Verification of equivalence properties in security protocols
  - Institution: BITS Pilani University (India)

- Anshul Malhotra (from Dec 2012 until Jan 2013)

    – Subject: Efficient implementation of a procedure for the verification of equivalence properties
    – Institution: IIT Delhi (India)

8.5.2. Visits to International Teams

- Véronique Cortier, February 2012 (one week), Bristol University (collaboration with Bogdan Warinschi)
- Christophe Ringeissen and Laurent Vigneron, December 2012 (two weeks), UTFSM Valparaíso (Inria Associate Team BANANAS)

PAREO Project-Team

7. Partnerships and Cooperations

7.1. 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).

7.1.1. FRAE QUARTEFT (2009-2012)

Participants: Jean-Christophe Bach, Horatiu Cirstea, Pierre-Etienne Moreau.

"QUARTEFT: QUAlifiable Real TimE Fiacre Transformations" is a research project funded by the FRAE (Fondation de Recherche pour l'Aéronautique et l'Espace). A first goal is to develop an extension of the Fiacre intermediate language to support real-time constructs. A second goal is to develop new model transformation techniques to translate this extended language, Fiacre-RT, into core Fiacre. One of the main difficulties consists in proposing transformation techniques that could be verified in a formal way. A more detailed presentation is available at http://quarteft.loria.fr/dokuwiki/.

7.2. International Research Visitors

7.2.1. Visits of International Scientists

Cooperation with Prof. Mark van den Brand from Technical University of Eindhoven.

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

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR Open-PEOPLE - Open Power and Energy Optimization PLatform and Estimator

Participants: Fabrice Vergnaud, Jérôme Vatrinet, Kévin Roussel, Olivier Zendra.

Open-PEOPLE initially gathers 5 partners from academia and 2 from industry. This project aims at providing a federative and open platform for the estimation and optimization of power and energy consumption in computer systems. The platform users will be able to evaluate application consumption on a hardware architecture chosen among a set of provided typical, parametric architectures. In the considered system, the components will be picked from a library of hardware and software components, be they parametric or not. It will be possible to perform the estimation at various stages of the specification refinement, thanks to a methodology based on multi-level, interoperable and exchangeable consumption models allowing an easy exploration of the design space. Thus, estimations results may be used to check the energy behaviour of a system developed with simulation platforms. Feedback about the application functional properties will allow further refining of the estimation results in Open-PEOPLE. A standardisation of consumption models will be proposed in order to allow interoperability and have easier exchanges with other platforms. The Open-PEOPLE library of consumption models will be extensible: new component models will be added as the user applicative requirements evolve and as implementation techniques progress. To do so, the software estimation platform that will be accessible via an Internet portal shall be linked to a hardware platform made of an automated measurement testbench, which will be controllable from the software platform. A standalone version will also be provided to meet the confidentiality requirements of industry. A library of applications benchmarks will be proposed to characterize new components and new architectures. In addition to the research work required to build methods for multi-level estimation in heterogeneous complex systems, research work shall be carried on in order to offer new methods and techniques making it possible to optimize consumption thanks to the results provided by Open-PEOPLE. Open-PEOPLE is hence geared towards academia to support research work pertaining to consumption estimation and optimization methods, as well as towards industry to estimate or optimize the consumption of future products.

This project ended in late 2012, and we hope to continue work in this direction through other subsequent projects.

8.1.2. BGLE DEPARTS

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

The project DEPARTS started on October 1st for five next years. This project is funded by the national funding program BGLE. TRIO team will propose solutions for probabilistic component-based models.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. PROARTIS

Title: ___PROARTIS___
Type: COOPERATION (ICT)
Defi: Embedded Systems Design
Instrument: Specific Targeted Research Project (STREP)
Duration: February 2010 - July 2013
Coordinator: Barcelona Supercomputong Center (Spain)
See also: ___http://www.proartis-project.eu/___

Participants: Liliana Cucu-Grosjean, Adriana Gogonel, Luca Santinelli, Codé Lo, Dorin 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 proposed approach will concentrate 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 will be a major turn from previous approaches that seek analyzability by trying to predict with cycle accuracy the state of hardware and software through analysis.

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

8.2.1.2. TIMMO-2-USE

Participants: Liliana Cucu-Grosjean, Aurélien Monot, Nicolas Navet, Françoise Simonot-Lion, Ammar Oulamara, Luca Santinelli, Dominique Bertrand, Cristian Maxim.

TRIO team participated to TIMMO-2-USE (http://timmo-2-use.org/) is an ITEA 2 European project. It started in November 2010 and ended in September 2012. TIMMO-2-USE addresses the specification, transition and exchange of different types of timing information throughout different steps of the development process. The general goal is to evaluate and enhance standards for different applications in the development by different technical use cases covering multiple abstraction levels and tools. For this, TIMMO-2-USE will bring the AUTOSAR standard, TADL and EAST-ADL2 into different applications like WCET analysis and in-the-loop scenarios. This will bring new algorithms and tools for the transition and conversion of timing information between different tools and abstraction level based on a new advanced methodology which, in turn, will be based on a combination of the TIMMO and the ATESST2 methodologies.

8.2.2. Collaborations in European Programs, except FP7

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

The TRIO team is involved in the HiPEAC (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"is currently being written, 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.

8.2.3. Collaborations with Major European Organizations

> Partner 1: University of York (U.K.)
> Sujet 1: probabilistic and statistical analysis of real-time systems
> Partner 2: Malardelan University (Sweden)
> Sujet 2: statistical analysis of real-time systems
> Partner 3: University of Edinburgh (U.K.)
> Sujet 3: energy modeling and optimisation of computing systems

8.3. International Research Visitors

8.3.1. Visits of International Scientists
- Rob Davis, University of York
- Marko Bertogna, University of Modena

8.3.2. Visits to International Teams

Luca Santinelli visited University of York and Rapita, York for one month in April 2012.

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

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR

The ANR blanc PRESAGE brings together computational geometers (from the VEGAS and GEOMETRICA 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).

6.2. International Research Visitors

6.2.1. Visits of International Scientists

William J. Lenhart, Williams College (USA), one year sabbatical until July 2012.

Boris Aronov, from NYU-Poly, visited the VEGAS project for 2 weeks in October.

Martin Tancer, Pavel Paták and Zuzana Safernová, from Charles Univ. in Prague, visited the VEGAS project for 1 week in August.

Hyo-Sil Kim (postdoc at POSTECH, South Korea) and Jae-Soon Ha (PhD student at KAIST, South Korea) visited the VEGAS project for 2 weeks in February.

VERIDIS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

Participants: Pascal Fontaine, Stephan Merz.

The DeCert (Deduction and Certification) project has been funded by ANR from 2009 to 2012 within its "Domaines émergents" program. It was coordinated by the Celtique project team of Inria Rennes, the other partners are academic teams from Inria Saclay (Proval) and Inria Sophia Antipolis (Marelle) as well as the CEA and the Systerel company. In Nancy, the project also involves members of the Cassis team, in particular Alain Giorgetti and Christophe Ringeissen.

The objective of the project has been to study certified decision procedures, including the design of appropriate certificates, the development of new certifying decision procedures, their combination, their integration with skeptical proof assistants such as Coq or Isabelle, and their use in application domains such as software verification or static analysis. The main lines of research concern questions of expressiveness vs. efficiency, certificates vs. proof objects, and the integration of certificates into verification environments. Our work within the project is related to veriT (see section 5.1), its proof production, and its integration with verification environments such as Isabelle or the TLA$^+$ proof environments (see section 5.2).

8.1.2. Inria Development Action VeriT

Participants: Pablo Federico Dobal, Pascal Fontaine.

Inria funds this project (started in 2011) for the future 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.

8.2. European Initiatives

8.2.1. Cooperation with TU Wien, Austria

Participants: Pascal Fontaine, Stephan Merz.

This project started in 2012 and 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.

A first workshop of one week took place in Vienna in spring, and gathered around 15 people, including Pascal Fontaine and Stephan Merz as well as a student from TU Graz. A second one-week workshop was organized in Nancy in the fall, with 12 participants including 5 researchers from Vienna, and one student from Univ. Paul Sabatier, Toulouse. The web page gives more information on this project.

8.3. International Initiatives

8.3.1. Participation In International Programs

8.3.1.1. Cooperation with Córdoba, Argentina

Participants: Pascal Fontaine, Stephan Merz.

This cooperation with the team of Carlos Areces (formerly a researcher at Inria Nancy) at the University of Córdoba is along two axes. First, we study symmetries for automated reasoning (and SMT) as a means to reduce the search space and improve efficiency. Second, we investigate automated reasoning techniques (and more specifically SMT) for modal logics and similar fragments of first-order logic. The cooperation is funded within the context of the IRSES project MEALS coordinated for Inria by Catuscia Palamidessi (Saclay).

Two PhD students from Córdoba visited Inria Nancy in Summer 2012: Ezequiel Orbe for two weeks, and Raul Fervari for one month. Carlos Areces also came to Nancy for two weeks. Pascal Fontaine and Stephan Merz visited Argentina in November where they spent two weeks in Córdoba working on the above subjects, and one week visiting our contacts at the universities of Rosario and Buenos Aires.

The team has a long term relationship with the Universities of Córdoba, Rosario and Buenos Aires, with frequent exchanges of students. One Internship student in 2012 was from Buenos Aires, and the newly recruited engineer is from Rosario.

8.3.1.2. Cooperation with Universidade Federal do Rio Grande de Norte, Brazil
Participants: David Déharbe, Pablo Federico 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 particularly with Prof. David Déharbe. David Déharbe visited VeriDis in July and October. Pascal Fontaine is scheduled to visit 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 is also supported by the Inria-CNPq project SMT-SAVeS from 2010 throughout early 2013.

8.3.1.3. Cooperation with Tiaret University
Participants: Dominique Méry, Stephan Merz.

Mostapha Belardi (Université Ibn Khaldoun de Tiaret), Camel Tanougast (LICM, Université de Lorraine), Dominique Méry and Stephan Merz have started a joint project entitled *CIPRONoC : Conception Incrémentale Prouvée pour pROtotypage rapide de NoC Tolérant aux Fautes à base de technologie FPGA*. The project is sponsored by the STIC Algérie program, which funded a visit of Mostapha Belardi and an internship of Hayat Daoud in 2012. The work led to the design of a model for a network on chip proposed by our partners from LICM. A short presentation has been published in a local workshop.

8.4. International Research Visitors

8.4.1. *Visits of International Scientists*

David Déharbe from Universidade Federal do Rio Grande de Norte, Brazil, visited VeriDis from July 9 to July 27 and from October 15 to October 26 in the context of the Inria-CNPq project SMT-SAVeS. The work resulted in several improvements of the veriT solver.

Thomas Sturm, from MPI für Informatik, and Ulrich Loup and Florian Corzilius, from RWTH Aachen, visited VeriDis from October 22nd to 26th, in the context of the ADT veriT for discussing techniques for non-linear arithmetic in SMT solving.

8.4.2. *International Internships*

- Rodrigo Castaño (from Sep 2012 until Dec 2012)
    - Subject: Methods for efficient SMT solving
    - Institution: University of Buenos Aires (Argentina)

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

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

- Stéphanie Salmon is a major member of ANR Project "VIVABRAIN" (Modèles Numériques, 2012) from 2013 to 2016.

8.1.2. Euratom-CEA projects

- Michel Mehrenberger is the coordinator 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 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. European Initiatives

8.2.1. Collaborations with Major European Organizations

E. Sonnendrücker: Max Planck Institut, Munich (Germany)

We will continue to collaborate with Eric Sonnendrücker on numerical and mathematical studies for plasma physics. We also collaborate on the SeLaLib project.

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

8. Partnerships and Cooperations

8.1. National Initiatives

Alexandre Munnier, Jean-François Scheid (co-leader), Takéo Takahashi and Marius Tucsnak are members of the project CPER AOC-MISN "Autopropulsion dans un Fluide à bas Reynolds" (AFR). Collaborative project with the CRAN laboratory (Centre de Recherche en Automatique de Nancy).

8.1.1. ANR

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

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.

TOSCA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- N. Champagnat and D. Villemonais are members of the ANR MANEGE (Modèles Aléatoires eN Écologie, Génétique et Évolution, started in 2009) 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

- N. Champagnat is member of the ANR MODECOL (Using mathematical MODeling to improve ECOLogical services of prairial ecosystems, which ended in August 2012), whose goal is to develop computational ecological modeling of terrestrial plants communities via the simulation of a prairie in relation with environmental data. This project focuses on developing an original toolbox that takes advantage of complementary mathematical disciplines (partial differential equations, individual-based stochastic modelling...) to assess ecological problems. Simulations will be extensively processed using distributed computing and webcomputing. Our target application concerns the setup of herbal strips around intensive cereal fields for purificating water from extra nitrate and pesticides, imposed by the European Common Agricultural Policy. http://ecobio.univ-rennes1.fr/modecol/gb/description.php

- S. Herrmann, J. Inglis, D. Talay and E. Tanré are member of the ANR MANDy (Mathematical Analysis of Neuronal Dynamics, started in 2009 under the direction of M. Thieullen, Univ. Paris 6). This project, which gathers mathematicians and neuroscientists, aims at developing mathematically rigorous approaches to neuroscience considering single neurons as well as interconnected neuronal populations. Our target is to conduct the mathematical analysis of existing models where there is still much work to be done and to enrich the modelling by proposing new models. See http://www.proba.jussieu.fr/pageperso/thieullen/MANDy/accueil.html for a more complete description of this project.

- 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

Participants: Mireille Bossy, Jacques Morice.

Carbon value and carbon tax in the context of renewable energies deployment Since January 2009, M. Bossy was member of a collaboration funded by the French Environment and Energy Management Agency (ADEME), involving the Center for Applied Mathematics (CMA) at Mines ParisTech, and COPRIN and TOSCA teams at Inria Sophia Antipolis. It focuses on a short term carbon value derived from the so-called financial *carbon market*, the European Union Emission Trading Scheme (EU ETS), which is a framework for GHG emissions reduction in European industry.

The objective of this project is to study the compatibility and complementarity of a carbon tax and a target for renewable energy deployment. As a first step, we are developing a method for assessing the EU ETS value. We consider the constraints related to emission allowances distributed through national plans of allocation (NAP) and the mechanisms of taxes that are taking place. The work will focus on electricity producers, key players in the market in its first phase (NAP-I, 2005-2007). The impact of the *Renewable Energies* park of the electricity producers on their own carbon value will be particularly studied.

We have selected the financial concept of indifference price as a relevant methodology to assess the European Union Emission Trading Scheme (EU ETS) value. In this setting, modelling strategies of production and emission of market quotas rely on stochastic optimal control problems and associated Hamilton-Jacobi-Bellman equations.

This year, we worked on game theoretic approach for the carbon market price, in the framewrok of a cap&trade program. Based on the Nash equilibrium concept, we derive an equilibrium price equation for the allowances. The analysis of this equation and its wellposedness strongly depend on the design of the penalty function.

The final report [30] synthesizes of the results of all the work of this 2009-2012 ADEME Convention

8.1.3. Promotion of Mathematics in the industry

D. Talay is the Vice-President of the Fondation d'Entreprise Natixis which aims to contribute to develop research in quantitative finance. He also serves as a member of the Scientific Committee of the Foundation.

D. Talay is a member of the Scientific Committee of the AMIESNational Agency aimed to promote interactions between Mathematics and Industry.

8.2. European Initiatives

8.2.1. FP7 Projects

- A. Lejay participates to the *Multifractionality* (action Marie Curie *International Research Staff Exchange Scheme* FP7-PEOPLE-IRSES-2008) with Nancy, Kiev, Israël and Cardiff (2009–2012).

8.3. International Initiatives

8.3.1. Inria Associate Team: ANESTOC

Title: Stochastic modelling of renewable energies

Inria principal investigator: Denis Talay

International Partner (Institution - Laboratory - Researcher):

Pontificia Universidad Católica de Chile (Chile) - ANESTOC - Rolando Rebolledo

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 approach to Pope's equations on wind dynamics; 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 the Catholic University of Chile. In addition, applications to ion-channel dynamics through cell membranes will be considered jointly with biophysicists of the CINV (Neuroscience Centre of Valparaíso).

8.3.2. Inria International Partners

- TOSCA participates to the NCCR FINRISK (Financial Risk) forum launched by the Swiss National Science Foundation and managed by the University of Zürich.

8.3.3. Participation In International Programs

- D. Talay was the international coordinator of the MathAmsud program 08MATH05 - Stochastic Analysis and Mathematical Physics Research Network which started in 2009, also involved M. Bossy, A. Lejay and E. Tanré, and ended this year.
- M. Bossy, , A. Lejay, D. Talay and E. Tanré are members of the CIRIC project *Stochastic Analysis of Renewable Energies: Ocean Energy and Wind Farms; dynamics and numerics* with Chile.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- L. Beznea (Simion Stoilow of the Institute of Mathematics of the Romanina Academy) has been visiting TOSCA Nancy for five weeks in April, November and December.
- Patricio Orio (Univ. of Valparaiso) visited TOSCA Sophia-Antipolis one week in October.
- The TOSCA *seminar* organized by J. Charrier and J. Inglis in Sophia Antipolis has received the following speakers: Rolando Rebolledo (Universidad de Chile), François Dufour (Université Bordeaux), Nicole El Karoui (Ecole Polytechnique, Palaiseau), Huyên Pham (Université Paris Diderot), Pierre Patie (Université Libre de Bruxelles), Pierre-Louis Lions (Collège de France), Nicolas Perrin (Inria Sophia Antipolis – Méditerranée), Philip Protter (Columbia University, USA), Mathieu Rosenbaum (CREST), Nicolas Bouleau (ENPC), Jean Jacod (Université Pierre et Marie Curie, Paris), Jonathan Mattingly (Duke University, USA), Patricio Orio (Universidad de Valparaìso, Chile), Carl Graham (Ecole Polytechnique, Palaiseau).

8.4.2. Internships

Souhail BOUKHEROUAA (from Mar 2012 until Aug 2012)
> Subject: Evaluation of Value-at-Risk and applications to portfolio management
> Institution: Université de Lorraine and Alphability

Yi LU (from May 2012 until July 2012)
> Subject: Asymptotic expansions methods for options prices.
> Institution: École Polytechnique

Rajarshi SARKHAR (from March 2012 until August 2012)
> Subject: The First Passage Time Problem
> Institution: University of Nice - Master Erasmus Mundus Mathmodes

Khaled SALHI (from Feb 2012 until Jun 2012)
> Subject: Uncertainties and stochastic volatility models
> Institution: Ecole Polytechnique de Tunisie (Tunisia)

8.4.3. Visits to International Teams

- M. Deaconu was invited one week by Fabio Nobile at the *Ecole Polytechnique Fédérale de Lausanne* in July.
- A. Lejay spend a month at the Bernoulli Center at Ecole Polytechnique Fédérale de Lausanne during the SPDE Semester.
- E. Tanré has visited University of Valparaìso and Pontifical University in Chile in January and March.

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

Co-direction of a PhD thesis by J-M. Monnez:

> Partner: Ecole de Hautes Etudes en Santé Publique (Rennes).
> Title: Influence of socio-economic and environmental characteristics on infant mortality.
> PhD thesis of M. Lalloué.

Regional project leaded by T. Bastogne:

> Partners: Contrat de Projets Etat-Région, MISN (Modélisation, Information et Système Numérique), Thème AOC (Analyse, Optimisation et Contrôle).
> Title: EMC2 (Experimental design, Modeling and Control in Cancerology).

8.2. National Initiatives

- C. Lacaux is member of the MATAIM (Modèles Anisotropes de Textures. Applications à l'Imagerie Médicale) ANR project, leaded by F. Richard (University of Provence).

- P. Vallois is member of the MASTERIE (Malliavin Stein Random Irregular Equation) ANR project, leaded by F. Russo (ENSTA, Paris).

- T. Bastogne is leader of the MOCOBIO (MOdeling and COntrol of heterogeneous systems in BIOlogy) CNRS-PEPS project.

- T. Bastogne is member of the PDTX (Active Nanoplatforms for Photodynamic Therapy) ANR project, lead by M. Verelst (Université Paul Sabatier, Toulouse)

- T. Bastogne is member of the Nano-VTP (Nanoparticles for Imaging and Vascular Photodynamic Treatment of Brain Tumors) ANR project, lead by M. Barberi-Heyob (Centre de Recherche en Automatique de Nancy, Centre Alexis Vautrin).

- T. Bastogne, C. Lacaux and S. Tindel are members of the OPTIQUE CNRS-PEPS project, lead by M. Thomassin (CRAN) and managed within Inria's framework by BIGS.

8.3. European Initiatives

8.3.1. *Collaborations with Major European Organizations*

Collaboration 1: Smoothness of density for noisy differential systems

> Partner 1: Imperial College, London (UK)
> Partner 2: Warwick University (UK)
> Subject: Smoothness of density for noisy differential systems

8.4. International Research Visitors

8.4.1. *Visits of International Scientists*

Visit of D. Nualart (Kansas University) for 1 month, May 2012.

8.4.1.1. Internships

- Raouf Souabni: Simulation of the light propagation in biological tissues. Application to interstitial photodynamic therapy. Advisor: T. Bastogne.
- Yosra Chemli: Applicability of an Exponential-Linear (E-L) model to describe the in vitro cell responses in photodynamic therapy. Advisor: T. Bastogne.
- Kevin Ziegelmeyer: Data Analysis for for liver cirrhosis prediction. Advisor: A. Muller-Gueudin.

CORTEX Project-Team

7. Partnerships and Cooperations

7.1. Regional initiatives

7.1.1. Action Situated Informatics of the CPER

Participants: Laurent Bougrain, Octave Boussaton, Thierry Viéville.

In the framework of the Contrat de Projet État Région, we are contributing to the axis IS (Informatique Située) through the project CoBras whose goal is to study reinforcement learning to better control a robotic arm in a Brain-Machine interface. We bought a JACO robotic arm for wheelchair by Kinova.

7.2. National initiatives

7.2.1. DGE Ministry grant COMAC "Optimized multitechnique control of aeronautic composite structures"

Participants: Laurent Bougrain, Octave Boussaton, Marie Tonnelier.

The goal of this three-years project is to develop a powerful system of control on site, in production and in exploitation, of aeronautical pieces made of composite. It takes up the challenge of the precise, fast and local inspection on composite pieces of aeronautical structures new or in service by using techniques of non-destructive control more effective and faster to increase the lifespans of the structures of planes. This project requires a decision-making system including fast methods of diagnostic based on several optical technics as non-destructive control.

7.2.2. ANR project KEOPS

Participants: Frédéric Alexandre, Laurent Bougrain, Thierry Viéville.

This «ANR Internal White Project» involving NEUROMATHCOMP and CORTEX 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 bio-engineering will seek convergence from experimental and analytical models, with a fine articulation between biologically inspired computation and nervous systems neural signal processing (coding / decoding) [23].

7.2.3. ANR project PHEROTAXIS

Participants: Dominique Martinez, Thomas Voegtlin.

How can animals so successfully locate odour 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).

7.2.4. Project CNRS PEPII: A large-scale, robotically embodied decision making model

Participants: Frédéric Alexandre, Nicolas Rougier, Thierry Viéville.

This project is a collaboration between the "Institut des Maladies neuro-dégénératives" (UMR 5293, team "Approche systémique de la Boucle Extrapyramidale"), Supélec ("Information, Multimodalité, Signal") and the Cortex team. This project aims at studying the decision making process viewed as a high-level brain function, actioned by a distributed network of cortical and sub-cortical structures, interconnected in positive and negative feedback loops.

7.2.5. Project CNRS PEPII IMAVO

Participants: Nicolas Rougier, Yann Boniface.

This project is a collaboration between the "Institut des Neurosciences Cognitives et Intégratives d'Aquitaine" (UMR 5287), the "Institut des Systèmes Intelligents et de Robotique" (Systèmes Intégrés Mobiles et Autonomes) and the LORIA (Maia and Cortex groups). This project aims at investigating model-free and model-based approaches in the decision process in order to propose a computational model of the decision process in simple tasks.

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. MathAna

Title: Mathematical Analysis of Anaesthesia

Type: IDEAS

Instrument: ERC Starting Grant (Starting)

Duration: January 2011 - December 2015

Coordinator: Inria (France)

Abstract: General anaesthesia is an important method in today's hospital practice and especially in surgery. To supervise the depth of anaesthesia during surgery, the anaesthesist applies electroencephalography (EEG) and monitors the brain activity of the subject on the scalp. The applied monitoring machine calculates the change of the power spectrum of the brain signals to indicate the anaesthetic depth. This procedure is based on the finding that the concentration increase of the anaesthetic drug changes the EEG-power spectrum in a significant way. Although this procedure is applied world-wide, the underlying neural mechanism of the spectrum change is still unknown. The project aims to elucidate the underlying neural mechanism by a detailed investigating a mathematical model of neural populations. The investigation is based on analytical calculations in a neural population model of the cortex involving intrinsic neural properties of brain areas and feedback loops to other areas, such as the loop between the cortex and the thalamus. Currently, there are two proposed mechanisms for the charactersic change of the power spectrum: a highly nonlinear jump in the activation (so-called phase transition) and a linear behaviour.

The project mainly focusses on the nonlinear jump to finally rule it out or support it. A subsequent comparison to previous experimenta results aims to fit the physiological parameters. Since the cortex population is embedded into a network of other cortical areas and the thalamus, the corresponding analytical investigations takes into account external stochastic (from other brain areas) and time-periodic (thalamic) forces. To this end it is necessary to develop several novel nonlinear analysis technique of neural populations to derive the power spectrum close to the phase transition and conditions for physiological parameters.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. Cortina, associate team with Chile

Participants: Frédéric Alexandre, Thierry Viéville, Laurent Bougrain.

The goal of this associate team is to combine our complementary expertise, from experimental biology and mathematical models (U de Valparaiso and U Federico Santa-Maria) to computational neuroscience (CORTEX and NEUROMATHCOMP), in order to develop common tools for the analysis and formalization of neural coding and related sensory-motor loops. Recording and modeling spike trains from the retina neural network, an accessible part of the brain, is a difficult task that our partnership can address, what constitute an excellent and unique opportunity to work together sharing our experience and to focus in developing computational tools for methodological innovations.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

7.5.1.1. Internships

Elaa TEFTEF (from Dec 2011 until Jun 2012)

> Subject: Formalisation de la transformation analogique / événementielle des mécanismes non-standards des cellules ganglionnaires de la rétine.

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

TARUN JAIN (from May 2012 until Aug 2012)

> Subject: Optimization of reconstruction of brain signals by neural population models

> Institution: IIT Delhi (India)

7.5.1.2. Visiting professors/researchers

Peter BEIM GRABEN (from 01/10/2012 until 22/12/2012)

> Funding: Inria Mathana

> Subject: Detection of metastable states in brain signals

> Institution: Humboldt University Berlin, Germany

Chahinez Meriem BENTAOUZA (from 17/11/2012 until 08/12/2012)

> Funding: University of Mostaganem

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

> Institution: University of Mostaganem, Algeria

Samira CHOURAQUI (from 01/04/2012 until 30/04/2012)

> Funding: University of Oran

> Subject: Modélisation des systèmes non linéaires par des réseaux de neurones

> Institution: University of Oran, Algeria

Fatiha HENDEL (from 12/01/2012 until 28/01/2012)

> Funding: University of Oran

> Subject: Apprentissage et classification automatique

> Institution: University of Oran, Algeria

Rodrigo SALAS FUENTES (from 20/04/2012 until 19/07/2012)

> Funding: Inria Cortina

> Subject: Event-based neural network weight adjustment

> Institution: Académico del Departamento de Ingeniería Biomédica, Facultad de Ciencias, Universidad de Valparaíso, Chile

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

7. Partnerships and Cooperations

7.1. Regional Initiatives

MASAIE has obtained a grant from Région Lorraine for a research project : "Dynamique des populations de pathogènes".

7.2. International Initiatives

7.2.1. Inria International Partners

- University Gaston Berger, St Louis, Senegal.
- University of Ouagadougou and Université Polytechnique de Bobo-Dioulaso, Burkina-Faso.
- University Hassan II, Casablanca, Morocco.
- University of Manitoba, Winnipeg, Canada.

7.2.2. Participation In International Programs

7.2.2.1. 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" for 4 years, has begun in January 2011.

A Brazilian network has been built in 2011, 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 :
- Fondation Oswaldo Cruz (Fiocruz, Rio). Principal investigator : Claudia Codeço
- l'université fédérale de l'état de Pernambuco, Recife (http://www.ufpe.br/ufpenova/); Principal investigator César Castilho;
- IMPA Rio de Janeiro

We investigate in 2012 the biological control of dengue by *Wolbachia*.

7.2.2.2. 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) (≈ 45 000 euro).

The Phd thesis of Lena Tendeng (MASAIE) is part of this project.

7.3. International Research Visitors

7.3.1. *Visits of International Scientists*

- Aboudramane GUIRO, Université Polytechnique de Bobo-Dioulaso, Burkina-Faso, March 25 to April 22, 2012.
- Patrick Deleenheer, University of Florida, Gainesville, FL, June 24-28, 2012.
- Diène Ngom, Université de Ziguinchor, Senegal, September 25 to October 18, 2012.
- Blaise Kone (université Ouagadougou) October 26-November 16, 2012.
- Beranrd Bonzi (université Ouagadougou) October 29-November 13,2012.

In the framework of CAPES-COFECUB

- Hyun Mo Yang (UNICAMP) : February 4-February 8, 2012.
- Max Oliveira de Souza (UFF Rio) February 19-March 3, 2012.
- Max Oliveira de Souza (UFF Rio) November 20-December 3, 2012.
- Moacyr Alvim Barbosa da Silva (FGV Rio) November 20-December 3, 2012.

7.3.2. *Visits to International Teams*

In the framework of CAPES-COFECUB, A. Iggidr and G. Sallet visit FGV and UNICAMP from October 28 to November 19, 2012 (see CAPES-COFECUB).

SHACRA Project-Team

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, EVASION and ASCLEPIOS. The development program of the ADT started in 2007. After 3 years of development, more than 600,000 lines of code have been developed, 80,000 downloads of SOFA have been counted on the Inria gForge, and we are about to finalize a new version of the public release.

8.1.2. Sofa Intermeds, AEN

SOFA Large Scale Initiative on Medical Simulation (AEN): The variety and complexity of Medicine, as well as its ethical importance in today's society, have been a strong motivation in many scientific and technical disciplines. The medical field has already been a domain of application for computer science and several tools, such as image processing, are now an integral part of modern medicine. Yet, there is no question that the integration of new technologies in Medicine will continue to rise in the future. In this context, the simulation of medical procedures, whether it is targeted at education, planning of interventions, or even guidance during complex procedures, will be a major element of the Medicine of the twenty-first century. The main objective of this large scale initiative is to leverage expertise from a few research teams at Inria to speed up the development of new ideas, models, algorithms in this very multi-disciplinary field. This initiative started in 2008, and involves several teams at Inria: SHACRA, EVASION, ASCLEPIOS, MOAIS, MAGRIT, and BUNRAKU. This program has been evaluated by a group of international experts in October 2010.

8.1.3. 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.

8.1.4. 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. For this reason, Stephane Cotin has moved to Strasbourg for two years (Sept 2011 to July 2013).

8.1.5. 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. International Research Visitors

8.2.1. Internships

Yiyi WEI (from Jan 2012 until Mar 2012)

Subject: Simulation of Coil Embolization using the Discrete Exterior Calculus Approach

Institution: Beihang University of Aeronautics and Astronautics (China)

ALGORILLE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

CPER MISN, EDGE project (2010-2013, 468k€).   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.

8.2. National Initiatives

8.2.1. 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.

USS-SimGrid   (2009–2012, 840k€) Martin Quinson is the principal investigator, funded by the ANR ARPEGE program. USS-SimGrid (Ultra Scalable Simulation with SimGrid) aims at improving the scalability of the SimGrid simulator to allow its use in Peer-to-Peer research in addition of Grid Computing research. The challenges to tackle included models being more scalable at the eventual price of slightly reduced accuracy, automatic instantiation of these models, tools to conduct experiments campaigns, as well as a partial parallelization of the simulator tool. This project was successfuly completed this year.

ANR SONGS   (2012–2015, 1800k€) Martin Quinson is also the principal investigator of a 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 set it as the reference in its domain (see Sections 6.3.1 and 6.3.2).

8.2.2. 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.

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.

8.3. International Research Visitors

8.3.1. *Visits of International Scientists*

8.3.1.1. *Internships*

Maximiliano GEIER (09/2012 - 03/2013)

Subject: Leveraging multiple experimentation methodologies to study P2P broadcast

Institution: University of Buenos Aires (Argentina)

8.3.2. *Visits to International Teams*

Martin Quinson was hosted as a visiting professor at university of Hawai'i at Manoa for one month in April 2012. He was invited by Prof. Casanova to pursue the collaboration on SimGrid, originally started by Prof. Casanova.

MADYNES Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

In 2012, the team was involved in the following initiative:

- CPER-SSS: in this initiative, the team did work on Scada networks security and P2P monitoring.

8.2. National Initiatives

8.2.1. ANR

The team did coordinate the VAMPIRE ANR Project which ended in october 2012. VAMPIRE is a research project funded by the French Research Agency (ANR, VERSO ANR-08-VERS-017) coordinated by the team. The goal of the project to investigate new thread security issues induced by Voice Over IP (VoIP) protocols and web2.0. Madynes has the lead on this project.

8.2.2. 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, we extended MPIGate (http://mpigate.loria.fr), a multi-protocol interface and gateway, by integrating a publisher-subscriber data distribution model of standard middleware (DDS and ROS). The first experimentations showed its good performance and its easy-to-use interface for transparent heterogenous data access (through either programmer API or end-user web interface) [12]. 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

Title: Univerself

Type: COOPERATION (ICT)

Defi: The Network of the Future

Instrument: Integrated Project (IP)

Duration: September 2010 - August 2013

Coordinator: Alcatel Lucent (France)

Others partners:

Universiteit Twente,

Alcatel Lucent Ireland,

Alcatel Lucent Deutschland,

Valtion Teknillinen Tutkimuskeskus (Finland),

University of Piraeus,

France Telecom,

Telecom Italia,

National University of Athens,

Fraunhofer-Gesellschaft zur 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).

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.

8.3.1.2. FI-WARE

Type: COOPERATION (ICT)

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

Instrument: Integrated Project (IP)

Duration: September 2011 - May 2014

Coordinator: Telefonica (Spain)

Others partners:Thales, SAP, Inria

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 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;

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

8.3.2. Collaborations with Major European Organizations

Partner 1: Univeristy of Luxembourg (Luxembourg)

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

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

Maroua BOUMESSOUER (from Mar 2012 until Aug 2012)

    Subject: Etude des vulnérabilités et des attaques dans le protocole de routage RPL

    Institution: Sup'Com Tunis (Tunisia)

Ayoub SOURY (from Mar 2012 until Aug 2012)

    Subject: Vulnerabilities Prevention in Industrial Control Systems

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

Bernardo LAMAS (from Mar 2012 until Aug 2012)

    Subject: Offensive Security for Industrial Control Systems

    Institution: National University of Rosario (Argentina)

Tarang CHUGH (from Mar 2012 until Aug 2012)

    Subject: Fairness Incentives for Multi-Protocol Cooperation in P2P Networks

    Institution: Indraprastha Institute of Information Technology (India)

SCORE Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. 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 indefinitely, 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.

7.1.2. ANR STREAMS ANR-10-SEGI-010 (2010–2013)

Participants: Gérald Oster [coordinator], Luc André, Claudia-Lavinia Ignat, 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 technics. 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 issues 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.

7.1.3. Wiki 3.0 (2009–2012)

Participants: Claudia-Lavinia Ignat [contact], Luc André, Gérald Oster, Gérôme Canals, Bogdan Flueras.

Partners: XWiki SAS, SCORE team and Mandriva.

Website: http://wiki30.xwikisas.com/

The Wiki 3.0 project (december 2009 - june 2012) was sponsored by the call for projects "Innovative Web" launched by the French Ministry of Economy. The objective of this project was the development of an open-source platform based on XWiki (http://www.xwiki.org) that addressed the three major evolution axes of collaborative Web: real-time collaboration, social interaction integrated into the production (chat, micro-blogging, etc) and on demand scalability (cloud computing). This platform should be competitive with major editors of collaborative Web developed by Google such as Google Wave, IBM and Microsoft. SCORE team was responsible with the design and integration of real-time editing features into the XWiki system. We designed solutions for a raw text editor as well as for a WYSIWYG editor for XWiki pages. The real-time wiki editor has been released as an extension of XWiki (http://extensions.xwiki.org/xwiki/bin/view/Extension/RealTime+Wiki+Editor).

7.1.4. 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.

7.1.5. 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 allow to design and deploy applications based on proven technologies provided by partners such as collaborative messaging system, integration and workflow technologies that will be extended in order to address Cloud Computing requirements. Available as an open-source Enterprise Social Netwotk, 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).

7.2. International Initiatives

7.2.1. GIS Interop Grande Région

Participants: Nacer Boudjlida [responsible], Khalid Benali, François Charoy, Olivier Perrin, Claude Godart.

Follow-up the INTEROP Network of Excellence, the INTEROP V-Lab (International Virtual Laboratory on interoperability, http://www.interop-vlab.eu/) has been officially created in Brussels on March 2007 as an international non-profit making association (serving the international interest). In this context, Nancy played also a leading role in the definition of the V-Lab and in the settlement of the so-called INTEROP V-Lab pole (a partner of the INTEROP V-Lab): the Grande Region pole. The institutions that compose the Grande Region pole are University of Namur, University of Paris I La Sorbonne, University Lyon II, INSA Lyon, INSA Strasbourg, the former University Henri Poincaré Nancy 1 and the former University Nancy 2. The pole is legally defined as a Scientific (International) Interest Group (Groupement d'Intérèt Scientifique or GIS). Its attachment to the INTEROP V-Lab has been achieved in may 2009. The role of the GIS is to animate regional scientific cooperation amongg the French GIS partners and Luxembourg (Henri Tudor Public Research center) and Belgium (University of Namur) as well as international cooperation since the INTEROP V-Lab encompasses lot of partners coming from the European Union and from China. Nacer Boudjlida is the head of the management committee of the INTEROP Grande Region and he is also a member of its scientific committee.

7.2.2. *Associate Team Inria VanaWeb*

SCORE is involved in the Associate Team Inria VanaWeb (with UTFSM Valparaìso, Chili) which is interested in autonomous constraint solving concepts and their application to composition problems for Web services. The coordinators of this project are Carlos Castro (UTFSM Valparaìso, Chili) and Christophe Ringeissen (CASSIS).

7.3. International Research Visitors

7.3.1. *Visits of International Scientists*

Valerie Shalin is an associate Professor in the Department of Psychology of Wright State University. She is a leading researcher in the domain of Human factors and she has a comprehensive expertise on empirical and analytic methods to support the design and evaluation of coordinated work. We are collaborating with her on an ongoing project that tries to understand the actual implications of real time collaboration.

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

6. Partnerships and Cooperations

6.1. Regional Initiatives

Our collaborative project "Meshing and PDEs" (cooperation with CORIDA team) aims at developing new techniques for discretizing and solving PDEs, by combining the expertise of the CORIDA team in mathematical modeling with the expertise of the ALICE team in geometry processing.

6.2. National Initiatives

Samuel Hornus has a continued cooperation with the Scientific Foundation Fourmentin-Guilbert on the Graphite-LifeExplorer software.

6.2.1. ANR

Sylvain Lefebvre has a continued collaboration with our industrial partners Allegorithmic and the CSTB through the ANR SIMILAR-CITIES.

Dmitry Sokolov is involved in the ANR COSINUS ModItère (ANR-09-COSI-014) which goal is to design a new geometric modeller based on fractal geometry. The aim of this work is to specify and develop a geometric modeler, based on the formalism of iterated function systems with the following objectives: access to a new universe of original, various, aesthetic shapes, modeling of conventional shapes (smooth surfaces, solids) and unconventional shapes (rough surfaces, porous solids) by defining and controlling the relief (surface state) and lacunarity (size and distribution of holes).

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

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 (Starting)

Duration: August 2008 - July 2013

Coordinator: Inria (France)

Abstract: GOODSHAPE involves several fundamental aspects of 3D modelling 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 (Starting)

Duration: December 2012 - November 2017

Coordinator: Inria (France)

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 my 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 modelling 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.

6.4. International Initiatives

6.4.1. *Participation In International Programs*

Sylvain Lefebvre continues his collaborations with Microsoft Research Asia (Xin Tong), the Hong Kong University (Li-Yi Wei), KIT (Carsten Dachsbacher), and started a new collaboration with ETH Zurik (Olga Sorkine). He was invited for seminars within the teams of Carsten Dachsbacher (KIT) and Rüdiger Westerman (TU Munich).

Bruno Lévy continues his collaborations with Hong-Kong University (Wenping Wang).

6.5. International Research Visitors

6.5.1. *Visits of International Scientists*

During this last year, our team has been visited by Carsten Dachsbacher, Mathäus Chajdas, Li-Yi Wei and Ivo Ihrke (MPII Sarrbruecken).

6.5.1.1. *Internships*

Samuel Hornus supervised Pulkit Bansal (Indian master student) as an Inria internship, on the modeling of RNA molecules.

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

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

- ANR ARTIS (2009-2013)
  Participants: M.O. Berger, E. Kerrien, M. Loosvelt.
  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 (2009-2012)
  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 [11].

- 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 simulation to exactly superimposes 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.

7.1.2. 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.

7.1.3. Institut Pascal, Université de Clermont-Ferrand

Since June 2012, we are 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.

7.2. European Initiatives

7.2.1. Collaborations with Major European Organizations

Partner 1: Imperial College, London.

Pierre-Frédéric Villard has a Honorary Research Fellow contract with Imperial College. The collaboration has involved 2 research visits in London in summer to mainly discuss about the ongoing work on parameters optimization. There was also a participation 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 modelling).

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. CPER "Informatique Située" project

Participants: Olivier Simonin, François Charpillet, Olivier Rochel ,, Amandine Dubois, Mihai Andries.

Ye-Qiong Song (Madynes team, LORIA-Inria) is an external collaborator.

The CPER MIS is a Lorraine region and Inria-Feder project. In this context the Informatique Située action aims at studying and experiment AI models for human assistance and intelligent home. We developed an experimental platform called "Smart Appartment", where we define and study the iTile network (6.2.4.2.1) and different multi-sensors systems for tracking functions. See http://infositu.loria.fr.

8.1.2. RNSC project AEGSST

Participant: Vincent Chevrier.

This project "Approche Enactive pour la Gouvernance des Systèmes Socio-Techniques" (AEGSST) is the consequence of the work undertaken within the GEST project funded by the IXXI ("Institut Rhône Alpin des Systèmes Complexes") and PEPS CNRS project GEST. It is labeled and funded by the Réseau National des Systèmes Complexes (RNSC).

This project aims at a fundamental level at proposing an enactive perspective for the governance issue in case of complex socio-technical systems, like public transportation systems or smart grids in energy domain. From a more applicative perspective, we seek at specifying a participatory and reflexive simulation system based on a multi-agent model.

This project gathers researchers coming from different domains (social cognition, decision theory, simulation, serious game, etc) in order to clarify interdisciplinary issues.

Several meetings were organized and a workshop occurred the 29 th November in Paris.

8.1.3. COMAC

Participants: Mauricio Araya, Marie Tonnelier, Vincent Thomas, Olivier Buffet, François Charpillet.

Laurent Bougrain (CORTEX team, LORIA) is an external collaborator.

The COMAC [6] project is part of the Materalia competitive cluster. The main objective of the project is to develop diagnosis tools for the low cost identification of defaults in aeronautic parts made of composite materials.

In the MAIA team, our research effort focuses more precisely on information gathering problems involving active sensors, i.e., an intelligent system which has to select the observations to perform (which sensor, where, at which resolution). Mauricio Araya's undergoing PhD looks precisely at the topic of Active Sensing (Section 6.1.2).

The project has ended in December 2012 and the main contributions of the MAIA and CORTEX teams are (1) the development of the iComac platform that gathers the information concerning the diagnosis procedures results obtained by all the partners (2) the development of Pie Diagnosis System (PDS), a demonstrative application which uses a POMDP approach to compute the optimal active diagnosis strategy, and hypertrees for visualization.

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[6]COMAC = *contrôle optimisé multi-techniques des aérostructures composites* / optimized multi-technique control of composite aeronautic parts

8.2. National Initiatives

8.2.1. CNRS PEPII project "IMAVO" (2011-2012)

Participant: Alain Dutech.

IMAVO, for "Interactions entre Modules pour l'Apprentissage dans un environnement VOlatile", is a PEPII project of the INSB institute of the CNRS. It involves Alain Marchand and Etienne Coutureau from the INCIA Lab of Bordeaux (Behavioral Neurosciences - INSB), Mehdi Khamassi and Benoît Girard from the ISIR Lab of Paris (Robotics and Neurosciences - INS2I), Alain Dutech and Nicolas Rougier from the Loria Lab of Nancy (Computational Neurosciences and Machine Learning - INS2I).

This project investigates *model-based* and *model-free* reinforcement learning approaches for rats learning in volatile environments (*i.e.* context and reward can change during learning). It aims at designing new concept for modularized decision-making systems, allowing a better understanding of the underlying neuro-biological process involved in rats and humans and applications in the field of autonomous robotics.

8.2.2. Inria AEN PAL Personally Assisted Living

Participants: François Charpillet, Olivier Simonin, Mihai Andries.

The PAL project is a national Inria Large Scale Initiative (Action d'Envergure Nationale) 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 developping intelligent environments and distributed tracking devices for people walking analysis and robotic assistance (smart tiles, 3D camera network, assistant robots), cf. Sec. 6.2.4.2.1 .

In 2012, we organized a Workshop PAL in Nancy, on November (http://pal.inria.fr). The PAL project funded the PhD. thesis of Mihai Andries, who started in october 2012.

8.2.3. PEA-DGA SUSIE 2009-12

Participants: François Charpillet, Olivier Simonin, Romain Mauffray.

This project relies on results and questions arising from the SMAART project (2006-08). During this project we adapted the EVAP algorithm, proposed in the PhD thesis of Arnaud Glad (Maia, 2011) to the patrol with UAVs, while providing a generic digital pheromone based patrolling simulator. Concerning sharing authority, we proposed an original interface to manipulate groups of UAVs.

The SUSIE project allowed to progress on two questions (i) studying and improving parameters of the EVAP algorithm through the SUSIE simulator (ii) defining new ways to manipulate pheromones fields in order to improve the sharing authority.

8.2.4. Inria ADT Percee (2011-13)

Participants: Olivier Simonin, François Charpillet, Olivier Rochel, Nicolas Beaufort.

Percee, for "Perception Distribuée pour Environnements Intelligents", is a project proposed by Maia and Madynes teams and funded by Inria. This ADT (Action de Developpement Technologique) supports our action in the PAL Inria National Scale Initiative (Personally Assisted Living, see 8.2.2).

The project deals with the development and the study of intelligent homes. Since two years we develop an experimental platform, the smart appartment. 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.

8.2.5. ANR

8.2.5.1. CART-O-MATIC ANR Carotte
Participants: Olivier Simonin, François Charpillet, Antoine Bautin, Nicolas Beaufort.

This project has been granted by ANR in the Robotics Carotte challenge (CArtographie par ROboT d'un TErritoire) from the *Contenus et Interactions* program (2009-2012). The project is funded with ca. 50000 EUR to purchase the robotics platform. The Maia team was also funded with a PhD fellowship (Antoine Bautin, defending his PhD in the beginning of year 2013). The Cartomatic consortium was formed by LISA/Angers University (leader) and Maia/LORIA team (and until 2011 by Wany robotics, Montpellier).

This project concerned the mapping of indoor structured but unknown environments, and the localization of objects, with one or several robots. We explored a decentralized multi-robot approach to achieve the challenge. We demonstrated the efficiency and robustness of the approach by winning the final edition of the contest (June 2012, Bourges). See Section 6.2.4.1.3 and the Web page Cartomatic project.

8.2.5.2. 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 will allow to define a behavioral model of olfactive processes. This work will also provide several applications, in particular the development of bio-inspired components hightly 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).

8.2.5.3. ANR project BARQ
Participants: Jörg Hoffmann, Olivier Buffet, Bruno Scherrer.

This project has been granted by ANR in the "Chaires d'Excellence" program. The project is funded with ca. 400000 EUR and will hire four non-permanent researchers (Doctorants and/or Postdocs). Jörg Hoffmann is the project leader, Olivier Buffet and Bruno Scherrer collaborate. Other collaborators from LORIA are Stephan Merz, Ammar Oulamara, and Martin Quinson. The project also has several international collaborators, in particular Prof. Blai Bonet (Universidad Simon Bolivar, Caracas, Venezuela), Prof. Carmel Domshlak (Technion Haifa, Israel), Prof. Hector Geffner (Universitat Pompeu Fabra, Barcelona, Spain), Dr. Malte Helmert (University of Freiburg, Germany), and Prof. Stephen Smith (CMU, Pittsburgh, USA).

The project unites research from four different areas, namely classical planning, probabilistic planning, model checking, and scheduling. The underlying common theme is the development of new methods for computing lower bounds via state aggregation. Specifically, the basic technique investigated allows explicit selection of states to aggregate, in exponentially large state spaces, via an incremental process interleaving it with state space re-construction steps. The two main research questions to be addressed are how to choose the states to aggregate, and how to effectively obtain, in practical scenarios, anytime methods providing solutions with increasingly tighter performance guarantees.

So far, we have hired Dr. Michael Katz as a PostDoc (for 2 years) working on classical planning, and Manel Tagorti as a PhD student (for 3 years) working on probabilistic planning. The Conseil Regional de Lorraine has accepted to co-finance, for 2011, 50% of the the position of Michael Katz for a period of 1 year. Chao-Wen Perng was funded from BARQ for an internship of 5 months during which she worked on her MSc report, laying some basis for the research direction to be followed by Manel Tagorti.

The project has stopped when Joerg Hoffmann left Inria.

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". The PhD of Mohamed Tlig, supervised by O. Simonin and O. Buffet, addresses "Reactive coordination for traffic adaptation in large situated multi-agent systems".

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 April 2012.
- Pr. Sukanta Das, Professor at the Department of Information Technology, BESU university (West Bengal, India), visited MaIA for three weeks in March 2012.

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

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.

Combining Numerical and Symbolical Methods for the Classification of Multi-valued and Interval Data (CM2ID)

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, in order to push the complexity barrier farther in the mining of complex data. Biological data, namely gene expression data, are used for test and evaluation of the combination of algorithms.

The project involves three teams, one Brazilian team and two French Inria teams, including specialists of clustering and classification methods. Thus the complementarity of the teams is ensured and, in addition, close contacts exist with experts of the domain of data for carrying on a complete evaluation of the results obtained by the combined algorithms expected to be designed during the project.

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.

One strategy to ease the execution of such data mining tasks is to use existing knowledge to restrict the search space and to assess the quality of the patterns found. This existing knowledge may be formalized in ontologies but also in other ways whose study is a research issue in this project. Once we are able to build knowledge models, we need to determine how to use such knowledge models, which is a second major research issue in this project. In particular, we want to design and evaluate mechanisms that allow the exploitation of existing knowledge for sake of improving data mining algorithms.

Finally, the computational complexity of the algorithms remains a major issue and we intend to address it through parallel algorithms. Data mining algorithms, in general, represent a challenge for sake of parallelization because they are irregular and intensive in terms of both computing and communication. Accordingly, in a first joint work, we developed a new parallel algorithm to build skycubes based on the Anthill framework developed at UFMG. The paper was presented in a local Brazilian Conference and an extended journal version will appear in a 2012 special issue of the International Journal of Parallel Programming.

8.1.1.3. International collaborations in Mining complex data
Participants: Mehwish Alam, Aleksey Buzmakov, Victor Codocedo, Adrien Coulet, Elias Egho, Ioanna Lykourentzou, Amedeo Napoli [contact person], Chedy Raïssi.

8.1.1.3.1. PICS CNRS CADOE

A first collaboration involves "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). At the moment, some elements of this methodology are existing and were used in text mining [86], [85], but this methodology should be completed and improved, especially regarding the applicability on complex data and the interoperability with knowledge representation modules.

8.1.1.3.2. Collaboration with HSE Moscow

A second collaboration involves Sergei Kusnetsov at Higher School of Economics in Moscow (HSE). Amedeo Napoli visited HSE laboratory in November 2012 (with the support of HSE) and Sergei Kuznetsov visited Inria NGE in August and in December 2012. These visits were the occasion of preparing a publications (submitted for the next year). This shows that the collaboration is on-going and that there is still a substantial research work to be done.

8.1.1.3.3. AGAUR Project: collaboration with UPC Barcelona

This project mainly involves Amedeo Napoli and Jaume Baixeries who is an Associate Professor at UPC Barcelona (Universitat Politècnica de Catalunya). Amedeo Napoli had a stay of roughly two months in December 2011 and May-June 2012. Both researchers have worked, jointly with Mehdi Kaytoue, on the characterization of functional dependencies in many-valued data with FCA and pattern structures. In this work, functional dependencies are directly taken into account and this shows a different but important capability of pattern structures to deal with complex data [30].

8.1.1.3.4. PHC Zenon (Cyprus)

A third collaboration –a PHC Zenon project– exists with Florent Domenach, associated professor at the University of Nicosia in Cyprus. This project is 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. These processes can be based on Galois connections but also on the so-called "overhangings", i.e. a kind of generalization of closure systems. Moreover, another interest is put on consensus theory where the objective is to find the better classification of a set of abjects according to a quality measure (this could be applied to ontologies). This year, there were two visits, one from Cyprus to France in October 2012 and the other from France to Cyprus in December 2012. Publications are currently submitted.

8.2. European Initiatives

8.2.1. FP7 Project DOVSA

DOVSA stands for "Development of Virtual Screening Algorithms: Exploring Multiple Ligand Binding Modes Using Spherical Harmonic Consensus Clustering". It is a European project (Type PEOPLE) funded as a "Marie Curie Intra-European Fellowships for Career Development (IEF)" from July 2010 until July 2012. The coordinator of the project is Inria NGE.

This project is aimed at advancing the state of the art in virtual drug screening by developing novel spherical harmonic-based consensus clustering algorithms. The main disease that will be targeted in this project is the acquired immune deficiency syndrome (AIDS), caused by the human immuno-deficiency virus (HIV). However, the approach will be quite generic and will be broadly applicable to many other diseases. The approach will be tested and validated using 40 well-known drug targets from the DUD dataset. It will then be used to screen the French Chimiothèque Nationale library of some 36000 compounds for novel ligands which will bind the CCR5 co-receptor and hence block HIV infection. A small list of candidate entry-blocking compounds will be sent to Barcelona for experimental testing. By extending the SH-based consensus clustering technique, this project will provide a generic tool to help deal with cases where multiple ligands may be associated with multiple pocket sub-sites or which may bind multiple targets, and it will help to find new HIV entry-blocking compounds.

8.3. National Initiatives

8.3.1. ANR

8.3.1.1. ANR Hybride

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

The Hybride research project 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, while 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. This combination of NLP and KDD methods for common objectives, can be viewed as a continuous process, based on a sequence of complex operations from NLP and KDD that reinforces itself through a feedback loop. 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 fundamental aspects of the Hybride project can be understood through the main steps of the knowledge discovery loop with a NLP/KDD perspective : (i) data preparation, (ii) data mining, (iii) interpretation and validation of the results, (iv) knowledge construction. At each step, new methods have to be designed for achieving this interrelated NLP/KDD loop. One of the outcomes of the project should be a system integrating the operations involved within the whole NLP/KDD loop, in the context of Orphanet for text analysis and production of new documentation on rare diseases. The implementation of such a system combines various interrelated aspects, namely natural language processing, knowledge discovery, data mining, and knowledge engineering. This original combination still remains a challenge in computer science.

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 Inria NGE (FCA, knowledge representation, pattern mining, text mining).

8.3.1.2. ANR Kolflow

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

Kolflow (http://kolflow.univ-nantes.fr/) is a 3-years 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, Score (LORIA), and Wimmics (Inria Sophia Antipolis).

8.3.1.3. ANR PEPSI: Polynomial Expansions of Protein Structures and Interactions
Participants: Dave 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 programme 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).

8.3.1.4. ANR 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 knowledge for other 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). 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 id to provide in decision support for improving healthcare in detecting for example typical or exceptional trajectories for planning with precision healthcare for a given population. In order to discover groups of patients showing similar health condition, treatments or journeys through the healthcare system, PCT are modeled as multilevel and multidimensional sequences of itemsets, using external knowledge on hospitals, medical procedures and diagnoses. Accordingly, a new algorithm [42] has been developed to mine sequential patterns.

8.3.2. Other National Inititives and Collaborations

8.3.2.1. PEPS Cryo-CA
Participant: Dave 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 Dave 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. In November 2012, a workshop funded by this project attracted some 60 participants (http://ccsb2012.loria.fr).

8.3.2.2. 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 collaborate on the NRPS toolbox [57]. 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.

8.4. Regional Initiatives

8.4.1. BioProLor

The Orpailleur team is member of the BioProLor consortium composed of 5 enterprises and 7 academic research teams. This consortium is funded for 2 years (2010-2012) by the AME ("Agence pour la Mobilisation Economique"). The objective of BioProLor is the design of a production filière for compounds with high added-value which originate from plants in Lorraine. The Orpailleur team and the associated start-up "Harmonic Pharma" are in charge of the computational aspects of this research work.

In addition, a CIFRE contract (2009-2012) was set up with Harmonic Pharma for funding the thesis of Emmanuel Bresso on the following subject: "Organisation et exploitation des connaissances sur les réseaux d'interactions biomoléculaires pour l'identification de gènes candidats et la caractérisation de profils d'effets secondaires de principes actifs".

8.4.2. Contrat Plan État Région" (CPER)

The links between the Regional Administration and LORIA are materialized through an administrative contract called "Contrat Plan État Région" (CPER) 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).

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

  An Inria experimental research platform is currently developed in the framework of MBI (http://bioinfo.loria.fr/Plateforme%20MBI). This platform is aimed at sharing data and computing resources. Its specific features are relative to biomolecules modeling, classification, and to data integration for data mining. In parallel with the bioinformatics platforms in Strasbourg, Reims, Lille, and Nancy-INIST, it constitutes the North-East node of RENABI ("Réseau National des Plateformes Bioinformatiques").

- "Traitement Automatique des Langues et des Connaissances" (TALC).

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

PAROLE Project-Team

8. Partnerships and Cooperations

8.1. European Initiatives

8.1.1. Collaborations in European Programs, except FP7

8.1.1.1. 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 segmentating of a corpus made up of English sentences uttered by French speakers and we analyzed specific problems encountered by French speakers when speaking English.

In the first part of the project we have investigated the phonetic segmentation of non-native speech and analyzed the precision of the phoneme boundaries as boundaries are critical for making duration-based diagnoses in computer assisted learning of the prosody of a foreign language. The experiments have shown that it is critical to include non-native pronunciation variants in the pronunciation lexicon used for forced alignment. However it is better to avoid introducing unusual variants. The best performance was achieved by introducing variants that were seen at least two times on some development non-native data set. A detailed analysis of the boundary precision was also carried out. It was observed that a good precision was achieved for boundaries between some classes of phonemes (as for example between plosives and vowels, fricatives and vowels, and so on). Hence such information should be taken into account either in choosing the words when designing the exercises, and/or in the diagnosis process.

During this year, a special attention was paid to checking the consistency of the recorded speech signal with the expected text. The goal behind that, is to detect speech utterances that do not match with the expected text because of learner's inattention (not pronouncing the expected words) or acquisition problems (truncation of the speech acquisition - the beginning or the end of the sentence is missing - or background noise troubles). In case of mismatch, no further processing is to be carried on; on the opposite, when the speech utterance matches the expected text, prosodic features will be analyzed in details in order to provide a prosodic diagnosis of the pronunciation and the adequate feedback. In order to detect a possible mismatch, several criteria are computed based on the comparison of the phonetic segmentation resulting from a forced alignment with the phonetic segmentation obtained with a phonetic-loop or with a word-loop grammar; these criteria are then combined by a classifier to decide if the speech utterance and the expected text matches or not (cf. section 6.2.3.2).

The automatic phonetic segmentation has been included in the JSNOORI software (cf. section 5.2), as well as other extensions specific to handling exercises for learning the prosody of a foreign language.

The detection of the fundamental frequency (F0) is a key aspect of tools developed for learning prosody of a foreign language. Errors in F0 detection compromise the diagnosis set about the learner's utterance and the modifications of the prosody as well. Since no method alone can be sufficiently robust we thus investigated the combination of three methods, Yin, the method proposed by de Cheveigné et al., an autocorrelation method and a spectral comb method already developed withinh JSnoori. The three methods were redeveloped in Matlab and combined with a neural network approach.

8.1.1.2. Emospeech

Program: Eurostar

Project acronym: Emospeech

Project title: Interagir naturellement et émotiennellement avec des environnements virtuels

Duration: 01/06/2009 to 01/06/2012

Coordinator: Artefacto

Other partners: Acapela Speech group

Abstract: The Emospeech project is an Eurostar project started on 1st June 2010 in cooperation with SMEs Artefacto (France) and Acapela (Belgium). This project comes within the scope of serious games and virtual worlds. If existing solutions reach a satisfying level of 3D physical immersion, they do not provide satisfactory natural language interactions. The objective is thus to add spoken interactions via automatic speech recognition and speech synthesis. EPI Parole and Talaris take part in this project and the contribution of Parole will be about the interaction between the virtual world, automatic speech recognition and the dialogue management.

With respect to the development of a speech recognition solution, a prototype was developed in the framework of a serious game, in collaboration with the Talaris team. The speech-based prototype, which relies on the Sphinx4 speech recognition engine, has made possible the collection of speech material, that has later been transcribed. Specialized lexicons have been developed by combining the task-specific vocabulary extracted from the documentation of the serious game, from the speech data collected using the prototype, and from the text data collected by the Talaris team using a text-based prototype, with the most frequent words selecting in broadcast new corpus. Acoustic models have also been adapted using collected speech material.

Parallel to this work, a client/server speech recognizer system has been developed. The client was developed to run on an iPad terminal. Its role mainly consists in recording the speech signal, sending it to the server, waiting for the speech recognition answer, and finally displaying the speech recognition results. The server, runs on a PC, and performs the actual speech recognition task.

SEMAGRAMME Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. SLAM: Schizophrenia and Language, Analysis and Modeling
Participants: Maxime Amblard [coordinator], Sylvain Pogodalla.

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.

Maxime Amblard is coordinating the pre-project which ended at the end of 2012. A new application on this topic is send for a 2013-2015 project to the Maison des Sciences de l'Homme de Lorraine (MSH–Lorraine, USR 3261), with the same leader. 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. 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).

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[3] 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.

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 resulution 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 [4].

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

It has been shown that the discourse structure of texts play a key role in their understanding. This is the case not only for both for human readers but also for 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 Initiatives

7.3.1. Participation In International Programs

7.3.1.1. PHC: Partenariats Hubert Curien

The team collaborates with the Utrecht Institues of Linguistics OTS (Utrecht University) in the framework of a Van Gogh action (Hubert Curien program). This collaborations is concerned with conservative extensions of Montague semantics.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- Prof. A. Hadj-Salah (Académie Algérienne de la Langue Arabe) visited Philippe de Groote (January, 10).

- Chris Blom and Yoad Winter (University of Utrecht) visited Philippe de Groote (March, 28-30).

7.4.2. Visits to International Teams

- Philippe de Groote and Sylvain Pogodalla visited Prof. Makoto Kanazawa at the National Institute of Informatics (NII, Tokyo, Japan).

- Philippe de Groote was invited speaker at the workshop 'Properties and Optionality in Syntax and Semantics', Utrecht, February, 13-14.

- Philippe de Groote visited Prof. Yoad Winter at the Utrecht Institute of Linguistics (Utrecht University, the Netherlands), May 23-25.

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