RESEARCH CENTER
Bordeaux - Sud-Ouest

FIELD

Activity Report 2013

Section Partnerships and Cooperations

Edition: 2014-03-19

LFANT Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANRPeace – Parameter spaces for Efficient Arithmetic and Curve security Evaluation

Participants: Bill Allombert, Karim Belabas, Jean-Marc Couveignes, Andreas Enge, Nicolas Mascot, Enea Milio, Aurel Page, Damien Robert.

http://chic2.gforge.inria.fr/

The PEACE project is joint between the research teams of Institut de Recherche en Mathématiques de Rennes (IRMAR), LFANT and Institut Mathématiques de Luminy (IML).

The project aims at constituting a comprehensive and coherent approach towards a better understanding of theoretical and algorithmic aspects of the discrete logarithm problem on algebraic curves of small genus. On the theoretical side, this includes an effective description of moduli spaces of curves and of abelian varieties, the maps that link these spaces and the objects they classify. The effective manipulation of moduli objects will allow us to develop a better understanding of the algorithmic difficulty of the discrete logarithm problem on curves, which may have dramatic consequences on the security and efficiency of already deployed cryptographic devices.

One of the anticipated outcomes of this proposal is a new set of general criteria for selecting and validating cryptographically secure curves (or families of curves) suitable for use in cryptography. Instead of publishing fixed curves, as is done in most standards, we aim at proposing generating rationales along with explicit theoretical and algorithmic criteria for their validation.

Meetings:

- Paris: 11/04–12/04, talks and mini-courses;
- Rennes: 02/12–03/12, talks.

8.1.2. ANRSimpatic – SIM and PAiring Theory for Information and Communications security

Participant: Damien Robert.

The SIMPATIC project is an industrial research project, formed by academic research teams and industrial partners: Orange Labs, École Normale Supérieure, INVIA, Oberthur Technologies, ST-Ericsson France, Université de Bordeaux 1, Université de Caen Basse-Normandie, Université de Paris 8.

The aim of the SIMPATIC project is to provide the most efficient and secure hardware/software implementation of a bilinear pairing in a SIM card. This implementation will then be used to improve and develop new cryptographic algorithms and protocols in the context of mobile phones and SIM cards. The project will more precisely focus on e-ticketing and e-cash, on cloud storage and on the security of contactless and of remote payment systems.

As a participant, D. Robert will aim to bridge the gap between the theoretical results described in the pairing module and the practical realisation of pairing-based SIM cards in an industrial setting.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. ANTICS

Title: Algorithmic Number Theory in Cryptology

Type: IDEAS

Instrument: ERC Starting Grant

Duration: January 2012 - December 2016

Coordinator: Inria (France)

Abstract: Data security and privacy protection are major challenges in the digital world. Cryptology contributes to solutions, and one of the goals of ANTICS is to develop the next generation public key cryptosystem, based on algebraic curves and abelian varieties. Challenges to be tackled are the complexity of computations, certification of the computed results and parallelisation, addressed by introducing more informatics into algorithmic number theory.

8.3. International Initiatives

8.3.1. Inria International Labs

The *MACISA* project-team (Mathematics Applied to Cryptology and Information Security in Africa) is one of the new teams of LIRIMA. Researchers from Inria and the universities of Bamenda, Bordeaux, Dakar, Franceville, Maroua, Ngaoundéré, Rennes, Yaoundé cooperate in this team.

The project is concerned with public key cryptology and more specifically the role played by algebraic maps in this context. The team focus on two themes:

- Theme 1 : Rings, primality, factoring and discrete logarithms;
- Theme 2 : Elliptic and hyperelliptic curve cryptography.

The project is managed by a team of five permanent researchers: G. Nkiet, coordinator of the project, J.-M. Couveignes, vice coordinator, T. Ezome and D. Robert, responsible for each of the two scientific working areas, A. Enge, head of the LFANT project team. The managing team organises the cooperation, schedules meetings, prepares reports, controls expenses, reports to the LIRIMA managing team and administrative staff.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Tony Ezome Mintsa, University of Franceville, Gabon, 02/2013 and 11–12/2013
- Loïc Grenie, University of Bergamo, 11–12/2013
- Matthias Waack, University of Leipzig, Germany, 10–11/2013
- Eduardo Friedman, University of Chile, 01–02/2013
- Francisco Diaz y Diaz, emeritus, 01–02/2013
- Bernadette Perrin-Riou, Université d'Orsay, 03/2013

8.4.1.1. Internships

- Fritz Hiesmayr, ÉNS Lyon, 06–07/2013
- Gregor Seiler, Technische Universität Berlin, Germany, 10/2013–03/2014

8.4.2. Visits to International Teams

D. Robert visited the cryptology team at Microsoft Research from August 06 to August 14.

ALEA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR BNPSI: Bayesian NonParametric methods for Signal and Image processing

Statistical methods have become more and more popular in signal and image processing over the past decades. These methods have been able to tackle various applications such as speech recognition, object tracking, image segmentation or restoration, classification, clustering, etc. We propose here to investigate the use of Bayesian nonparametric methods in statistical signal and image processing. Similarly to Bayesian parametric methods, this set of methods is concerned with the elicitation of prior and computation of posterior distributions, but now on infinite-dimensional parameter spaces. Although these methods have become very popular in statistics and machine learning over the last 15 years, their potential is largely underexploited in signal and image processing. The aim of the overall project, which gathers researchers in applied probabilities, statistics, machine learning and signal and image processing, is to develop a new framework for the statistical signal and image processing communities. Based on results from statistics and machine learning we aim at defining new models, methods and algorithms for statistical signal and image processing. Applications to hyperspectral image analysis, image segmentation, GPS localization, image restoration or space-time tomographic reconstruction will allow various concrete illustrations of the theoretical advances and validation on real data coming from realistic contexts.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. ACOBSEC

Type: PEOPLE

Instrument: International Research Staff Exchange Scheme

Objectif: NC

Duration: November 2013 - October 2016

Coordinator: Pierrick Legrand

Partner:

Inria contact: Pierrick Legrand

Abstract: Over the last decade, Human-Computer Interaction (HCI) has grown and matured as a field. Gone are the days when only a mouse and keyboard could be used to interact with a computer. The most ambitious of such interfaces are Brain-Computer Interaction (BCI) systems. The goal in BCI is to allow a person to interact with an artificial system using only brain activity. The most common approach towards BCI is to analyse, categorize and interpret Electroencephalography (EEG) signals, in such a way that they alter the state of a computer. The objective of the present project is to study the development of computer systems for the automatic analysis and classification of mental states of vigilance; i.e., a person's state of alertness. Such a task is relevant to diverse domains, where a person is expected or required to be in a particular state. However, this problem is by no means a trivial one. In fact, EEG signals are known to be highly noisy, irregular and tend to vary significantly from person to person, making the development of general techniques a very difficult scientific endeavor.
List of Beneficiaries

- Beneficiary 1 (coordinator) Institut National de Recherche en Informatique et Automatique Inria France
- Beneficiary 2 Universite Victor Segalen Bordeaux II UB2 France

- Beneficiary 3 Instituto de Engenharia de Sistemas e Computadores, Investigacao e Desenvolvimento em Lisboa INESC-ID Portugal
- Beneficiary 4 Universidad de Extremadura UNEX Spain
- Partner 5 Instituto Tecnologico de Tijuana ITT Mexico
- Partner 6 Centro de Investigacion Cientifica y educacion Superior de Ensenada, Baja California CICESE Mexico

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Declared Inria International Partners

- Institut Technologique de Tijuana. TREE-LAB: www.tree-lab.org Tijuana, BC, Mexico

8.4. International Research Visitors

8.4.1. Visits of International Scientists

The following researchers visited the Team ALEA during 2013: J. Blanchet (Colombia University), A. Doucet (Univ. Oxford), A. Greaven (Univ. Erlangen).

8.4.2. Visits to International Teams

Pierre Del Moral: new South Wales university, Sydney.

BACCHUS Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

Title: TIDES: Robust simulation tools for non-hydrostatic free surface flows

Type: Apple à Porjets Recherche du Conseil de la Région Aquitaine

Grant: 55Keuros (co-funding PhD A. Filippini)

Coordinator: M. Ricchiuto

Other partners: UMR EPOC (P. Bonneton)

Abstract: This project proposes to combine modern high order adaptive finite elements techniques with state of the art nonlinear and non-hydrostatic models for free sruface waves to provide an accurate tool for the simulation of near shore hydrodynamics, with application to the study and prediction of tidal bores. The Garonne river will be used as a case study.

7.2. National Initiatives

7.2.1. Inria Project Lab

7.2.1.1. C2S@Exa - Computer and Computational Scienecs at Exascale

Participants: Olivier Aumage [RUNTIME project-team, Inria Bordeaux - Sud-Ouest], Jocelyne Erhel [SAGE project-team, Inria Rennes - Bretagne Atlantique], Philippe Helluy [TONUS project-team, Inria Nancy - Grand-Est], Laura Grigori [ALPINE project-team, Inria Saclay - Île-de-France], Jean-Yves L'excellent [ROMA project-team, Inria Grenoble - Rhône-Alpes], Thierry Gautier [MOAIS project-team, Inria Grenoble - Rhône-Alpes], Luc Giraud [HIEPACS project-team, Inria Bordeaux - Sud-Ouest], Michel Kern [POMDAPI project-team, Inria Paris - Rocquencourt], Stéphane Lanteri [Coordinator of the project], François Pellegrini [BACCHUS project-team, Inria Bordeaux - Sud-Ouest], Christian Perez [AVALON project-team, Inria Grenoble - Rhône-Alpes], Frédéric Vivien [ROMA project-team, Inria Grenoble - Rhône-Alpes].

Since January 2013, the team is participating to the C2S@Exa http://www-sop.inria.fr/c2s_at_exa Inria Project Lab (IPL). This national initiative aims at the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society. At the current state of the art in technologies and methodologies, a multidisciplinary approach is required to overcome the challenges raised by the development of highly scalable numerical simulation software that can exploit computing platforms offering several hundreds of thousands of cores. Hence, the main objective of C2S@Exa is the establishment of a continuum of expertise in the computer science and numerical mathematics domains, by gathering researchers from Inria project-teams whose research and development activities are tightly linked to high performance computing issues in these domains. More precisely, this collaborative effort involves computer scientists that are experts of programming models, environments and tools for harnessing massively parallel systems, algorithmists that propose algorithms and contribute to generic libraries and core solvers in order to take benefit from all the parallelism levels with the main goal of optimal scaling on very large numbers of computing entities and, numerical mathematicians that are studying numerical schemes and scalable solvers for systems of partial differential equations in view of the simulation of very large-scale problems.

7.2.1.2. ANR

Title: PETALH: Preconditioning scientific applications on pETascALe Heterogeneuous machines

Type: ANR

Grant: Cosinus 2010

Duration: September 2011 - May 2013

Coordinator: GRIGORI Laura (Inria Saclay-Île de France)

Other partners: Inria Saclay-Île de France (leader of the project), Paris 6, IFP (Rueil-Malmaison), CEA Saclay.

See also: http://petal.saclay.inria.fr/

Abstract: In this collaborative effort, we propose to develop parallel preconditioning techniques for the emergent hierarchical models of clusters of multi-core processors, as used for example in future petascale machines. The preconditioning techniques are based on recent progress obtained in combining the well known incomplete LU (ILU) factorization with tangential filtering.

The track we are following in order to contribute to this goal is to investigate improved graph ordering techniques that would privilege the diagonal dominance of the matrices corresponding to the subdomains of the Schur complement. It amounts to integrating numerical values into the adjacency graph of the matrices, so that the importance of off-diagonal terms is taken into account when computing graph separators. The core of this work is planned to take place at the beginning of next year.

This project is a continuation of PETAL project that was funded by ANR Cosinus 2008 call.

7.2.1.3. FUI Rodin

Title: Robust structural Optimization for Design in Industry (Rodin)

Type: FUI

Duration: July 2012 - July 2015

Coordinator: ALBERTELLI Marc (Renault)

Abstract: From the research point of view, the RODIN project will focus on: (1) extending level set methods to nonlinear mechanical or multiphysics models and to complex geometrical constraints, (2) developing algorithms for moving meshes with a possible change of topology, (3) adapting in a level-set framework second-order optimization algorithms having the ability of handling a large number of design variables and constraints.

The project will last 3 years and will be supported by a consortium of 7 partners: (1) 2 significant end-users, Renault and EADS, who will provide use-cases reflecting industrial complexity; (2) 3 academics partners, CMAP, J.-L. Lions laboratory and Inria of Bordeaux, who will bring expertise in applied mathematics, structural optimization and mesh deformation; (3) A software editor, ESI Group, who will provide mechanical software package and will pave the way of an industrialization; (4) A SME, Eurodecision, specialized in large-scale optimization.

7.2.1.3.1. ANR MAIDESC

Title: Maillages adaptatifs pour les interfaces instationnaires avec deformations, etirements, courbures.

Type: ANR

Duration: 48 months

Starting date : 1st Oct 2013

Coordinator: Dervieux Alain (Inria Sophia)

Abstract: Mesh adaptive numerical methods allow computations which are otherwise impossible due to the computational resources required. We address in the proposed research several well identified main obstacles in order to maintain a high-order convergence for unsteady Computational Mechanics involving moving interfaces separating and coupling continuous media. A priori and a posteriori error analysis of Partial Differential Equations on static and moving meshes will be developed from interpolation error, goal-oriented error, and norm-oriented error. From the minimization of the chosen error, an optimal unsteady metric is defined. The optimal metric is then converted into a sequence of anisotropic unstructured adapted meshes by means of mesh regeneration, deformation, high stretching, and curvature. A particular effort will be devoted to build an accurate representation of physical phenomena involving curved boundaries and interfaces. In association with curved boundaries, a part of studies will address third-order accurate mesh adaption. Mesh optimality produces a nonlinear system coupling the physical fields (velocities, etc.) and the geometrical ones (unsteady metric, including mesh motion). Parallel solution algorithms for the implicit coupling of these different fields will be developed. Addressing efficiently these issues is a compulsory condition for the simulation of a number of challenging physical phenomena related to industrial unsolved or insufficiently solved problems. Non-trivial benchmark tests will be shared by consortium partners and by external attendees to workshops organized by the consortium. The various advances will be used by SME partners and proposed in software market.

7.2.1.3.2. ANR UFO

Title: Uncertainty quantification For compressible fluid dynamics and Optimisation.

Type: ANR

Duration: 36 months

Starting date : 1st June 2011

Coordinator: Remi Abgrall (Inria Bordeaux Sud-Ouest)

Abstract: This project deals with the simulation and the optimization of stochastic flows where the uncertainties can be both in the data and in the models. The focus will be on handling the uncertainties coming from the turbulence models or thermodynamics models in dense-gas flows. Since the thermodynamic models for dense-gas flows are not well-known, it is mandatory to compute the probability density functions of some quantities of interest by starting from the experimental data. Several methods have been developed for both reducing the global computational cost and increasing the accuracy in the statistics computation.

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. IDIHOM

Title: Industrialisation of High-Order Methods

Type: COOPERATION (TRANSPORTS)

Instrument: Specific Targeted Research Project (STREP)

Duration: October 2010 - September 2013

Coordinator: Deutsches Zentrum fur Luft und Raumfahrt (Germany)

Others partners: DLR (Germany), Dassault Aviation (France), EADS-Cassidian (Germany), Cenaero (Belgium), Numeca (Belgium), ARA (UK), FOI (Sweden), Inria (france), NLR (the Nederlands), ONERA (France), TSAGI (Russia), ENSAM (France), Imperial College (UK), Universities of Bergamo (Italy), Varsaw (Poland), Poznan (Poland), Linköping (Sweden), UniversitĆatholique de Louvain (Belgium).

See also: http://www.dlr.de/as/en/desktopdefault.aspx/tabid-7027/11654_read-27492/

Abstract:The proposed IDIHOM project is motivated by the increasing demand of the European aerospace industries to advance their CFD-aided design procedure and analysis by using accurate and fast numerical methods, so-called high-order methods. They will be assessed and improved in a top-down approach by utilising industrially relevant complex test cases, so-called application challenges in the general area of turbulent steady and unsteady aerodynamic flows, covering external and internal aerodynamics as well as aeroelastic and aeroacoustic applications. Thus, the major aim is to support the European aeronautics industry with proven-track method(s) delivering an increased predictive accuracy for complex flows and (by same accuracy) an alleviation of computational costs which will secure their global leadership. An enhancement of the complete "high-order methods suite" is envisaged, including the most relevant methods, Discontinuous Galerkin and Continuous Residual-Based methods, in combination with underlying technologies as high-order grid generation and adaptation, visualisation, and parallelisation. The IDIHOM project is a key-enabler for meeting the ACARE goals, as higher-order methods offer the potential of more accurate prediction and at the same time faster simulations. Inria is involved in the design of Continuous Residual-Based methods for the simulation of steady trubulent flows.

7.3.1.2. STORM

Type: COOPERATION

Defi: NC

Instrument: Specific Targeted Research Project

Objectif: NC

Duration: October 2013 - September 2016

Coordinator: SNECMA (France)

Partner: SNECMA SA (FR), AEROTEX UK LLP (UK), AIRBUS OPERATIONS SL (ES), Airbus Operations Limites (UK), AIRCELLE SA (FR), ARTTIC (FR), CENTRO ITALIANO RICERCHE AEROSPAZIALI SCPA (IT), CRANFIELD UNIVERSITY (UK), DEUTSCHES ZENTRUM FUER LUFT - UND RAUMFAHRT EV (DE), EADS DEUTSCHLAND GMBH (DE), ONERA (FR), TECHSAPACE AERO SA (BE)

Inria contact: Heloise Beaugendre

Abstract: During the different phases of a flight, aircraft face severe icing conditions. When this ice then breaks away, and is ingested through the reminder of the engine and nacelle it creates multiple damages which have a serious negative impact on the operations costs and may also generate some incident issues. To minimise ice accretion, propulsion systems (engine and nacelle) are equipped with Ice Protection Systems (IPS), which however have themselves performance issues. Design methodologies used to characterise icing conditions are based on empirical methods and past experience. Cautious design margins are used non-optimised designs solutions. In addition, engine and nacelle manufacturers are now limited in their future architectures solutions development because of lack of knowledge of icing behaviour within the next generation of propulsive systems solutions, and of new regulations adopted that require aero engine manufacturers to address an extended range of icing conditions.

In this context that STORM proposes to: characterise ice accretion and release through partial tests ; Model ice accretion, ice release and ice trajectories ; Develop validated tools for runback ; characterise ice phobic coatings ; select and develop innovative low cost and low energy anti-icing and de-icing systems. Thus, STORM will strengthen the predictability of the industrial design tools and reduce the number of tests needed. It will permit lower design margins of aircraft systems, and thus reduce the energy consumption as well as prevent incidents and break downs due to icing issues.

7.3.1.3. ADDECCO

Title: ADaptive schemes for DEterministic and stoChastiC Flow PrOblems (ADDECCO)

Type: IDEAS (AdG # 226316)

Instrument: ERC Advanced Grant (Advanced)

Duration: December 2008 - November 2013

Coordinator: Inria (France)

Others partners: none

See also: http://www.math.u-bordeaux.fr/~rabgrall

Abstract: The numerical simulation of complex compressible flow problem is still a challenge nowadays, even for the simplest physical model such as the Euler and Navier Stokes equations for perfect gases. Researchers in scientific computing need to understand how to obtain efficient, stable, very accurate schemes on complex 3D geometries that are easy to code and to maintain, with good scalability on massively parallel machines. Many people work on these topics, but our opinion is that new challenges have to be tackled in order to combine the outcomes of several branches of scientific computing to get simpler algorithms of better quality without sacrificing their efficiency properties. In this proposal, we will tackle several hard points to overcome for the success of this program. We first consider the problem of how to design methods that can handle easily mesh refinement, in particular near the boundary, the locations where the most interesting engineering quantities have to be evaluated. CAD tools enable to describe the geometry, then a mesh is generated which itself is used by a numerical scheme. Hence, any mesh refinement process is not directly connected with the CAD. This situation prevents the spread of mesh adaptation techniques in industry and we propose a method to overcome this even for steep problems. Second, we consider the problem of handling the extremely complex patterns that occur in a flow because of boundary layers: it is not always sufficient to only increase the number of degrees of freedom or the formal accuracy of the scheme. We propose to overcome this with class of very high order numerical schemes that can utilise solution dependant basis functions. Our third item is about handling unsteady uncertainties in the model, for example in the geometry or the boundary conditions. This need to be done efficiently: the amount of computation increases a priori linearly with the number of uncertain parameters. We propose a non–intrusive method that is able to deal with general probability density functions (pdf), and also able to handle pdfs that may evolve during the simulation via a stochastic optimisation algorithm, for example. This will be combined with the first two items of this proposal. Many random variables may be needed, the curse of dimensionality will be dealt thanks to multiresolution method combined with sparse grid methods. The aim of this proposal is to design, develop and evaluate solutions to each of these challenges. Currently, and up to our knowledge, none of these problems have been dealt with for compressible flows with steep patterns as in many moderns aerodynamics industrial problems. We propose a work program that will lead to significant breakthroughs for flow simulations with a clear impact on numerical schemes and industrial applications. Our solutions, though developed and evaluated on flow problems, have a wider potential and could be considered for any physical problem that are essentially hyperbolic.

7.3.2. TRP Contract with European Space Agency

- Contrat ESA AO /1-6938/11/NL/SFE) for uncertainty quantification in aerospace application.
- Starting Date : 1st June 2012
- Coordinator : Thierry Magin (VKI)
- Type : ESA (European Spatial Agency).
- Grant : 250.000 euros
- Abstract: this project deals with the development of uncertainty quantification methods for aerospace applications. This is the first project financed by ESA concerning uncertainty quantification. The approach that we propose to follow will be based on the quantification and reduction of all the uncertainties, thoroughly identified, in a balanced manner. A fundamental characteristic of this integrated simulation strategy must be also the ability to control the numerical errors present in the highly integrated computations.

7.4. International Initiatives

7.4.1. Inria Associate Teams

AQUARIUS associated team is a research project dealing with uncertainty quantification and numerical simulation of high Reynolds number flows. It represents a challenging study demanding accurate and efficient numerical methods. It involves the Inria team BACCHUS and the groups of Pr. Charbel Farhat from the Department of Aeronautics and Astronautics and Pr. G. Iaccarino from the Department of Mechanical Engineering at Stanford University. The first topic concerns the simulation of flows when only partial information about the physics or the simulation conditions (initial conditions, boundary conditions) is available. In particular we are interested in developing methods to be used in complex flows where the uncertainties represented as random variables can have arbitrary probability density functions. The second topic focuses on the accurate and efficient simulation of high Reynolds number flows. Two different approaches are developed (one relying on the XFEM technology, and one on the Discontinuous Enrichment Method (DEM), with the coupling based on Lagrange multipliers). The purpose of the proposed project is twofold : i) to conduct a critical comparison of the approaches of the two groups (Stanford and Inria) on each topic in order to create a synergy which will lead to improving the status of our individual research efforts in these areas ; ii) to apply improved methods to realistic problems in high Reynolds number flow.

A summary of research activities, publications, visits can be found on http://www.stanford.edu/group/uq/aquarius/index3.html

7.4.2. Inria International Partners

7.4.2.1. Informal International Partners

von Karman Institute for Fluid Dynamics (Belgium). With Pr. H. Deconinck we work on the design of high order methods, including goal oriented mesh adaptation strategies

Leeds University, School of Computing : Dr. M.E. Hubbard (as of January 2014 in University of Nottingham, Department of Mathematics). Collaboration on high order schemes for time dependent shallow water flows

Technical University of Crete, School of Production Engineering & Management : Pr. A.I. Delis. Collaboration on high order schemes for depth averaged free surface flow models, including robust code to code validation

LEGI, Grenoble : Collaboration with C. Corre, E. Goncalves and G. Balarac on uncertainty quantification methods, multiphase flows, cavitation and turbulence.

CWI, The Netherlands : Collaboration with J. Witteveen about the Simplex2 methods for robust design optimization.

University of Trieste : Collaboration with V. Pediroda and L. Parussini concerning robust optimization methods.

Politecnico di Milano, Aerospace Department (Italy) : Pr. A. Guardone. Collaboration on ALE for complex flows (compressible flows with complex equations of state, free surface flows with moving shorelines), and on robust optimization methods for morphing helicopter blades.

7.4.3. Inria International Labs

7.4.3.1. JLPC

In the context of the JLPC (Joint Laboratory for Petascale Computing), people involved in the development of graph partitioning algorithms in `Scotch` collaborate with several US partners (UIUC, Argonne) so as to improve partitioning run time and quality for large scale simulations. Sébastien Fourestier has been attending the Inria-UIUC meeting of last September and has delivered two talks, one regarding `Scotch` and the other regarding `PaMPA`.

7.4.3.2. Inria@SILICONVALLEY

People involved in the development of graph partitioning algorithms in `Scotch` have a loose collaboration with Sherry Li and her team at Berkeley, regarding sparse matrix reordering techniques.

7.4.4. Participation In other International Programs

7.4.4.1. Inria-CNPq

In the context of the `HOSCAR` project jointly funded by Inria and CNPq, coordinated by Stéphane LANTERI on the French side, François Pellegrini and Pierre Ramet have participated in a joint workshop in Petrópolis last September. A collaboration is envisioned regarding parallel graph partitioning algorithms for data placement in the context of big data applications.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

- Kazuo AOKI, Kyoto University (Kyoto, Japan), from August 31st to September 9th ;
- Smadar KARNI, University of Michigan Ann Arbor (Ann Arbor, Michigan, USA), from January 15th to March 23rd ;
- Alexander KURGANOV, Tulane University (New-Orleans, USA), from July 8th to July 13th ;
- Dimitris VALOUGEORGIS, University of Thessaly (Grece), from June 24th to July 5th ;
- Federica VIGNATI, Politecnico di Milano (Italy), from May 6th to May 18th ;
- Bernhard MULLER, NTNU Trondheim (Norway), on sabbatical from October 2013 to May 2014.

We also received a large number of shorter visits (on/two days) from several internationally recognized scientists : M. Pelanti (ENSTA PArisTech, France), S. Takata (Kyito University, Japan), E. Audit (CEA, France), E. Caron (Ecole Nomale Superieur Lyon, France), C. Corre (LEGI Grenoble, France), H. Deconinck (von Karman Institute, Belgium), B. Despres (Université Paris VI, France), M. Giles (Oxford University, UK), D. Lucor (Université Paris VI, France), H. Meyerhenke (KIT, Germany), C. Poloni (Università di Trieste, Italy), P. Sagaut (Université P. et M. Curie, France), P. Siarry (UPEC, France), and many others.

7.5.1.1. Internships

- Paola BACIGALUPPI. From April to October. Subject : Wave breaking modeling in a stabilized finite element code. University : Politecnico di Milano. Supervisor : M. Ricchiuto ;
- Sophie DALLET. From March to August. Subject : Approximation de modèles multiphase par mèthodes aux résidus. Supervisor : R. Abgrall ;
- Marc DUVERNET. From March to June. Subject : Coupler un code numérique qui résout les équations du mélange liquide-vapeur avec un code pour la quantification des incertitudes basé sur un cadre bayésien. Supervisor : P. Congedo ;
- Simon ETTOUATI. From February to August. Subject : Déformation de maillage pour les maillages d'ordre élevé. Supervisor : C. Dobrzynski ;
- Andrea FILIPPINI. From January to April. Subject : Stabilized finite element modeling of non-hydrostatic wave propagation. University : Politecnico di Milano. Supervisor : M. Ricchiuto ;
- Adballa MANSOURI. From March to June. Subject : Génération d'un modèle thermodynamique complexe pour les gaz réels. Supervisor : P. Congedo ;
- Léo NOUVEAU. From February to August. Subject : Etude sur les mèthodes de pénalisation adaptées aux maillages non-structurés fortement anisotropiques et utilisation de l'adaptation de maillage. Supervisor : H. Beaugendre ;
- Nassim RAZAALY. From Ferbuary to July. Subject : Modifier un code de simulation numérique d'ordre élevé pour implémenter des modèles thermodynamiques précis. University : ENSEIRB-MATMECA. Supervisor : P. Congedo.

7.5.2. Visits to International Teams

- P.M. Congedo, Stanford University (USA), two weeks in May 2013.
- P.M. Congedo, University of Salento (Italy), two weeks in August 2013.
- G. Geraci, Stanford University, 1 month in August 2013.

CAGIRE Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. An experimental database for DNS assessment (6 months of post-doct funded by Communauté d'Agglomération Pau- Portes des Pyrénées)

The quality of our unsteady simulations have to be compared with high quality experimental data. Since the targeted baseline 1-jet in crossflow configuration is isothermal, the relevant comparisons will be made mainly on the velocity field for which detailed PIV measurements have to be carried out. In order to assess in depth the quality of our numerical simulations, it is important to generate experimental data that must give access to both the global flowfield statistics (one-point mean values and probability density functions) as well as the velocity field dynamics (spectra) and the most relevant related turbulence scales. In that framework, the objective of this one-year post-doc (co-funded by CNRS and UPPA) is to built-up a stereo-PIV based database giving access simultaneously to the three velocity components in the planes of measurement.

7.2. National Initiatives

7.2.1. GIS Success

We are presently participating in the CNRS GIS Success (Groupement d'Intérêt Scientifique) organised around the two major codes employed by the Safran group, namely AVBP and Yales 2. In the framework of mastering the Yales2 code, one team member has participated in October 2013 in a training session organised by Coria. Then, the yales2 code has been implemented locally and the evaluation of the code has started.

7.3. European Initiatives

7.3.1. FP7 Projects

Participants: Vincent Perrier [responsible of the team contribution], Pascal Bruel [substitute], Simon Delmas [PhD], Yann Moguen [Post-doc].

Program: Propulsion

Project acronym: IMPACT-AE

Project title: Intelligent Design Methodologies for Low Pollutant Combustors for Aero-Engines

Duration: 01/11/2011 - 31/10/2015

Coordinator: Roll Royce Deutschland

Other partners:

- France: Insa of Rouen, ONERA, Snecma, Turbomeca.
- Germany: Rolls-Royce Deutschland, MTU Aeo Engine Gmbh, DLR, Technology Institute of Karlsruhe, University of Bundeswehr (Munich)
- Italy: AVIOPROP SRL, AVIO S.P.A., University of Florence
- United Kingdom: Rolls Royce PLC, Cambridge University, Imperial College od Science, Technology and Medecine, Loughborough University.

Abstract: The environmental benefits of low emissions lean burn technology in reducing NOx emissions up to 80only be effective when these are deployed to a large range of new aero-engine applications. While integrating methodologies for advanced engine architectures and thermodynamic cycles. It will support European engine manufacturers to pick up and keep pace with the US competitors, being already able to exploit their new low emission combustion technology to various engine applications with short turn-around times. Key element of the project will be the development and validation of design methods for low emissions combustors to reduce NOx and CO emissions by an optimization of the combustor aero-design process. Preliminary combustor design tools will be coupled with advanced parametrisation and automation tools. Improved heat transfer and NOx models will increase the accuracy of the numerical prediction. The contribution of our team is to create with AeroSol a direct numerical simulations (DNS) database relevant to the configuration of film cooling for subsequent improvement of RANS based simulations of isothermal and non isothermal wall flows with discrete mass transfer.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

June 2013 (4 days): Prof. E. Dick from Ghent University: improvement of pressure-velocity coupling for low Mach number flow simulation by introducing inertia terms in the flux scheme.

7.4.2. Visits to International Teams

P. Bruel spent a two-week stay at the Institute of Mathematics in Almaty (Kazakhstan) to set-up a joint projet around the simulations of combustion of air and coal in a laboratory scale burner. A joint supervision of a Kazakh student was started at this occasion.

CONCHA Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

...

8.2. National Initiatives

8.2.1. ANR

8.2.2. Competitivity Clusters

8.2.3. Autres sections...

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.2. Collaborations in European Programs, except FP7

8.3.3. Collaborations with Major European Organizations

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.2. Inria International Partners

8.4.2.1. Declared Inria International Partners

8.4.2.2. Informal International Partners

8.4.3. Inria International Labs

8.4.4. Participation In other International Programs

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

8.5.2. Visits to International Teams

CQFD Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. PSI : Psychology and Sound Interactions

The aim of this project was to develop a classifier to automatically determine the alertness state of humans from electroencephalographic (EEG) signals. Such a task is relevant to diverse domains, where a person is expected to be in a highly alert state. The goal was to contrust a Brain-Computer Interface (BCI) based on synthetized music to modify alterness state of a person. This Région Aquitaine grant (2010-2013) grant included the PHD-grant of Laurent Vezard.

8.1.2. Chaire Inria-Astrium-EADS IW-Conseil régional d'Aquitaine

The chaire is funding the PhD thesis of Christophe Nivot on the optimization of the assembly line of the future European launcher.

8.2. National Initiatives

8.2.1. ANR FAUTOCOES

The goal of the project "FAUTOCOES" (number ANR-09-SEGI-004) of the ARPEGE program of the French National Agency of Research (ANR) can be described as follows. Today, complex technological processes must maintain an acceptable behavior in the event of random structural perturbations, such as failures or component degradation. Aerospace engineering provides numerous examples of such situations: an aircraft has to pursue its mission even if some gyroscopes are out of order, a space shuttle has to succeed in its re-entry trip with a failed on-board computer. Failed or degraded operating modes are parts of an embedded system history and should therefore be accounted for during the control synthesis.

These few basic examples show that complex systems like embedded systems are inherently vulnerable to failure of components and their reliability has to be improved through fault-tolerant control. Embedded systems require mathematical representations which are in essence dynamic, multi-model and stochastic. This increasing complexity poses a genuine scientific challenge:

- to model explicitly and realistically the dynamical interactions existing between the physical state variables defining the system: pressure, temperature, flow rate, intensity, etc, and the functional and dysfunctional behavior of its components;
- to estimate the performance of the system through the evaluation of reliability indexes such as availability, quality, and safety;
- to optimize the control to prevent system failures, as well as to maintain the system function when a failure has occurred.

Our aim is to meet the previously mentioned challenge by using the framework of piecewise deterministic Markov processes (PDMP's in short) with an emphasis on probabilistic and deterministic numerical methods. More precisely, our objectives are

- to use the framework of piecewise deterministic Markov processes to model complex physical systems and phenomena;
- to compute expectations of functionals of the process in order to evaluate the performance of the system;
- to develop theoretical and numerical control tools for PDMP's to optimize the performance and/or to maintain system function when a failure has occurred.

More details are available at http://fautocoes.bordeaux.inria.fr/.

8.2.2. ANR ADAPTEAU

The ANR project ADAPTEAU has been obtained for the period 2012-2016 and will start in january 2012.

ADAPTEAU aims to contribute to the analysis and management of global change impacts and adaptation patterns in River-Estuarine Environments (REEs) by interpreting the scientific challenges associated with climate change in terms of: i) scale mismatches; ii) uncertainty and cognitive biases between social actors; iii) interdisciplinary dialogue on the "adaptation" concept; iv) critical insights on adaptive governance and actions, v) understanding the diversity of professional, social and economic practices vis-à-vis global change. The project aims to build an integrative and interdisciplinary framework involving biophysical and social sciences, as well as stakeholders and civil society partners. The main objective is to identify adaptive strategies able to face the stakes of global change in REEs, on the basis of what we call 'innovative adaptation options'.

We consider the adaptation of Social-Ecological Systems (SES) through the expected variations of the hydrological regimes (floods / low-flow) of the Garonne-Gironde REE—a salient issue in SW France, yet with a high potential for genericity The ADAPTEAU project will be organised as follows:

- Achieve and confront socio-economic and environmental assessments of expected CC impacts on the Garonne-Gironde river-estuarine continuum (task 1);
- Identify the emerging 'innovative adaptation options' endorsed by various social, economic, political actors of the territory (depolderisation, 'room for rivers' strategies, changes in economic activities, agricultural systems or social practices), then test their environmental, economic and social robustness through a selected subset (task 2);
- Scientists, representatives from administrators and civil society collaborate to build adaptation scenarios, and discuss them in pluralistic arenas in order to evaluate their social and economic feasibility, as well as the most appropriate governance modes (task 3).
- Disseminate the adaptation strategies to academics and managers, as well as to the broader society (task 4).

  The expected results are the definition and diffusion of new regional-scale reference frameworks for the discussion of adaptation scenarios in REE and other SESs, as well as action guidelines to better address climate change stakes.

The CQFD team work on tasks 1 and 3.

8.2.3. ANR Piece

ANR Piece (2013-2016) of the program *Jeunes chercheuses et jeunes chercheurs* of the French National Agency of Research (ANR), lead by F. Malrieu (Univ. Tours). The Piecewise Deterministic Markov Processes (PDMP) are non-diffusive stochastic processes which naturally appear in many areas of applications as communication networks, neuron activities, biological populations or reliability of complex systems. Their mathematical study has been intensively carried out in the past two decades but many challenging problems remain completely open. This project aims at federating a group of experts with different backgrounds (probability, statistics, analysis, partial derivative equations, modeling) in order to pool everyone's knowledge and create new tools to study PDMPs. The main lines of the project relate to estimation, simulation and asymptotic behaviors (long time, large populations, multi-scale problems) in the various contexts of application.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Numerical methods for Markov decision processes (2013-2015) This project is funded by the Gobierno de Espana, Derccion Genral de Investigacion Cinetifica y Tecnica (reference number: MTM2012-31393) for three years to support the scientific collaboration between Tomas Prieto-Rumeau and François Dufour. This research project is concerned with numerical methods for Markov decision processes (MDPs). Namely, we are interested in approximating numerically the optimal value function and the optimal controls for different classes of constrained and unconstrained MDPs. Our methods are based on combining the linear programming formulation of an MDP with a discretization procedure —referred to as quantization— of a probability distribution, underlying the random transitions of the dynamic system. We are concerned with optimality criteria such as the total expected cost criterion (for finite horizon problems) and, on the other hand, the total expected discounted cost and the average cost optimality criteria (for infinite horizon problems).

8.4. International Initiatives

8.4.1. Participation In other International Programs

Control of Dynamic Systems Subject to Stochastic Jumps USP-COFECUB grant (2013-2016). The main goals of this joint cooperation will be to study the control of dynamic systems subject to stochastic jumps. Three topics will be considered throughout the next 3 years. In the first topic we will study the control problem of piecewise-deterministic Markov processes (PDMP's) considering constraints. In this case the main goal is to obtain a theoretical formulation for the equivalence between the original optimal control of PDMP's with constrains and an infinite dimensional static linear optimization problem over a space of occupation measures of the controlled process. F. Dufour at Inria and O. Costa in USP will mainly carry out this topic. In the second topic we will focus on numerical methods for solving control and filtering problems related to Markov jump linear systems (MJLS). This project will allow a first cooperation between B. de Saporta and E. Costa. The third research subject will be focused on quantum control by using Lyapunov-like stochastic methods and P. Rouchon and P. Pereira da Silva will conduct it.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Eduardo Costa (Univ. São Paulo), invited from July 22nd to August 1st 2013, USP-COFECUB grant.

8.5.2. Visits to International Teams

Benoîte de Saporta was invited one week (April 22-April 29) by Jian-Fang Yao at the University of Hong Kong. Benoîte de Saporta was invited three weeks (May 22-June 8) by Eduardo Costa at the University of São Paulo in São Carlos, Brazil (USP-COFECUB grant).

GEOSTAT Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

- ICARODE [2013-2016]. Participants : Hussein Yahia, Oriol Pont, Véronique Garçon, Joel Sudre, Antonio Turiel, Christine Provost [LOCEAN]. 4-year contract, CNES-NASA funding, started 2013. Title: *ICARODE: Integration and cascading for high resolution ocean dynamics*. Project leader: H. Yahia.
- IHU LIRYC and CRA DIAFIL project [2012-2014]. Post-doctoral fellow: B. Xu. Project leaders H. Yahia and O. Bernus.
- REGION AQUITAINE PROJECT "OPTAD". Participants : H. Yahia, S. Kumar Maji. Project leader: H. Yahia.

7.2. European Initiatives

7.2.1. Collaborations in European Programs, except FP7

Program: ESA (European Spatial Agency) Support to Science Element

Project acronym: OceanFlux

Project title: High resolution mapping of GHGs exchange fluxes.

Duration: 09/2011 - 09/2014

Coordinator: C. Garbe

Other partners: IWR (University of Heidelberg), LEGOS (CNRS DR-14), GEOSTAT (Inria), KIT (Karlsruher Institut fur Technologie, Frankfurt), IRD, Université Paul Sabatier.

Abstract: The EBUS (Eastern Boundary Upwelling Systems) and OMZs (Oxygen Minimum Zone) contribute very significantly to the gas exchange between the ocean and the atmosphere, notably with respect to the greenhouse gases (hereafter GHG). Invasion or outgasing fluxes of radiatively-active gases at the air-sea interface result in coupled or decoupled sink and source configurations. From in-situ ocean measurements, the uncertainty of the net global ocean-atmosphere CO2 fluxes is between 20 and 30%, and could be much higher in the EBUS-OMZ. Off Peru, very few in-situ data are available presently, which justifies alternative approaches for assessing the fluxes. GHG vertical column densities (VCD) can be extracted from satellite spectrometers. The accuracy of these VCDs need to be very high in order to make extraction of sources feasible. To achieve this accuracy is extremely challenging, particularly above water bodies, as water strongly absorbs infra-red (IR) radiation. To increase the amount of reflected light, specular reflections (sun glint) can be used on some instruments such as GOSAT. Also, denoising techniques from image processing may be used for improving the signal-to-noise ratio (SNR). GHG air-sea fluxes determination can be inferred from inverse modeling applied to VCDs, using state of the art modeling, at low spatial resolution. For accurately linking sources of GHGs to EBUS and OMZs, the resolution of the source regions needs to be increased. This task develops on new non-linear and multiscale processing methods for complex signals to infer a higher spatial resolution mapping of the fluxes and the associated sinks and sources between the atmosphere and the ocean. Such an inference takes into account the cascading properties of physical variables across the scales in complex signals. The use of coupled satellite data (e.g. SST and/or Ocean colour) that carry turbulence information associated to ocean dynamics is taken into account at unprecedented detail level to incorporate turbulence effects in the evaluation of the air-sea fluxes. We will present a framework as described above for determining sources and sinks of GHG from satellite remote sensing. The approach includes resolutions enhancements from nonlinear and multiscale processing methods. The applicability is validated against ground truth observations and numerical model studies.

7.3. International Initiatives

- Project "Profilage à partir des données hétérogènes du Web pour la cybersécurité" funded by the Canadian CRSNG (3 years) is in its last year. The partners in this project are: Univ of Sherbrooke, Concordia Univ, Sûreté du Québec, the company E-Profile and GEOSTAT. related publication: [23].
- The Volubilis project "Study of Upwelling in the Moroccan coast by satellite imaging" led by K. Daoudi is in its last year. The partners in this project are: Faculté des sciences de Rabat (FSR), Centre Royal de Télédetection Spatiale (CRTS), LEGOS-CNRS (Toulouse) and GEOSTAT.

7.3.1. Inria Associate Teams

A project of Associate Team with Indian Partner IIT Roorkee is submitted for 2014. This EA team project comes in cunjunction with accepted IFCAM project (Indo-French Centre for Applied Mathematics)*Optimal inference in complex and turbulent data*.

7.3.2. Inria International Partners

7.3.2.1. Informal International Partners

IIT Roorkee: Indo-French Centre for Applied Mathematics (IFCAM) project [2014-2017] and submitted Associated Team project (2014).

7.3.3. Participation In other International Programs

- IFCAM (India): Indo-French Centre for Applied Mathematics (IFCAM) project [2014-2017]. Title: *Optimal inference in complex and turbulent data*. 3-year contract, IFCAM funding, started 2014. Partners: GEOSTAT and IIT ROORKEE (INDIA).

7.4. International Research Visitors

7.4.1. Visits of International Scientists

7.4.1.1. Internships

Safa Mrad

Subject: Nonlinear speech analysis for pathological voice detection.

Date: from April 2013 until September 2013.

Report: [41].

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

Nicolas Vinuesa

Subject: Matching pursuit for efficient speech coding.

Date: from October 2012 until Avril 2013.

Report: [44]

Institution: Facultad de Ciencias Exactas, Ingenieria y Agrimensura (FCEIA), UNR (Rosario, Argentina)

Blaise Bertrac

Subject: Matching pursuit for pathological voice classification.

Date: June and July 2013.

Report: [40].

Institution: Université de Bordeaux-1.

MC2 Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Angelo Iollo is belongs to the Aerospace Valley committee IGPC. He is monitoring the project ECOSEA for the fnrae http://www.fnrae.org/.

8.2. National Initiatives

8.2.1. ANR CARPEiNTER

Participants: Héloïse Beaugendre, Michel Bergmann, Charles-Henri Bruneau, Angelo Iollo [Leader Project], Lisl Weynans.

Cartesian grid, penalization method, complex flow. The P.I. is Angelo Iollo. See http://www.math.u-bordeaux1.fr/CARPEINTER/

8.2.2. ANR CYCLOBULLE

Participants: Charles-Henri Bruneau, Yong Liang Xiang.

The formation and dynamics of long lived coherent structures in atmospheric flows can be mimicked by soap film experiments on an hemisphere heated at the equator. The aim of this work is to simulate such flows and to compare both to the experiments and to the known data of various tornados.

8.2.3. ANR INTCELL

Participants: Thierry Colin, Olivier Saut, Clair Poignard.

The members T.Colin, C.Poignard and O.Saut are involved in the consortium INTCELL directed by P.LEVEQUE (XLIM), and which begun in December 2010. This mutlidisciplinary project, composed of four partners (XLIM laboratory, Vectorology and Anticancer therapies team at the IGR, EDAM and MC2) aims at studying the electropermeabilization by nanopulses at the subcellular level. The goal is to develop new electrical devices and accurate models to understand the electropermeabilization of the cytoplasm constituents such as the nuclear envelop or the mitochondrial membrane, based on the experiments and on the simulations of molecular dynamics.

8.2.4. ANR MEMOVE

Participants: Mathieu Colin, Thierry Colin, Angelo Iollo, Clair Poignard, Olivier Saut, Lisl Weynans.

Part of the team (M.Colin, T.Colin, A.Iollo, C.Poignard, O.Saut and L. Weynans) are involved in the consortium MEMOVE coordinanted by MC2 (coordinator C. Poignard), and which begins at the begining of 2012. This consortium is composed of four partners (the Vectorology and Anticancer therapies team at the IGR, the bioengineering laboratory AMPERE of Lyon and the Department of mathematics of Versailles). It aims at developing electropermeabilization models from the cell scale to the tissue scale. This project focuses on quite long pulses (from micro- to milli-pulses) compared with the ANR consortium INTCELL that has begun in december 2010. The main goal is to provide multi-scale modelling of "classical" eletroporation, in order to obtain numerical tools that can help from one side the biologists to understand the electropermeabilization process when "non standard" pulses are applied, and from the other side it eventually aims at providing tools for the physicians to optimize the pulse delivering when the electrochemotherapy is used.

8.2.5. PEPS CaRaMel3d

- Program: PEPS Idex-CNRS
- Project acronym: CaRaMel3d
- Project title: Calibration et Recalage sur l'Imagerie Médicale
- Duration: 07/2012-07/2013
- Coordinator: Olivier Saut
- Other partners: Institut Bergonié, CHU Pellegrin (Bordeaux),

8.2.6. French-German cooperative consortium SmartOnline

Participants: Angelo Iollo, Iraj Mortazavi.

- Program: ANR & BMBF
- Project acronym: SmartOnline
- Project title: Online security management toolkit for water distribution networks.
- Duration: 04/2012-04/2015
- Coordinator: Olivier Piller (IRSTEA)
- Other partners: Irstea, Veolia, ENGES, CU Strasbourg, BW Berlin, TZW Dresden, 3S Consult, Franhoefer.
- Abstract: The main objective of the project SMaRT-OnlineWDN is the development of an online security management toolkit for water distribution networks that is based on sensor measurements of water quality as well as water quantity. Its field of application ranges from detection of deliberate contamination, including source identification and decision support for effective countermeasures, to improved operation and control of a WDN under normal and abnormal conditions (dual benefit).

8.2.7. Plan Cancer, biologie des systemes

Participant: Thierry Colin.

- Program: Modeling cancer biology and treatment
- Project acronym: METASTASIS
- Project title: Modeling the Interaction of the (Metastasis) Vascular/Tumor Niche Using a Systems Biology Approach
- Duration: 2013-2015
- Coordinator: A. Bikfalvi (Biologie, Universite de Bordeaux)

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. FFAST

Title: FUTURE FAST AEROELASTIC SIMULATION TECHNOLOGIES

Type: COOPERATION (TRANSPORTS)

Instrument: Specific Targeted Research Project (STREP)

Duration: January 2010 - December 2012

Coordinator: University of Bristol (Saint Pierre And Miquelon)

Other partners: University of Bristol, irias, TU Delft, Politecnico di Milano, Numeca, EADS, DLR, Airbus, University of Cap Town, csir, Optimad.

See also: http://www.bris.ac.uk/aerodynamics-research/ffast/

Abstract: The FFAST project aims to develop, implement and assess simulation technologies to accelerate future aircraft design. These technologies will demonstrate a step change in the efficiency and accuracy of the dynamic aeroelastic "loads process" using unique critical load identification methods and reduced order modeling. The outcome from the project will contribute to the industrial need to reduce the number of dynamic loads cases analyzed, whilst increasing the accuracy and reducing the cost/time for each unsteady aeroelastic analysis performed compared to the current approach. Unsteady loads calculations play an important part across much of the design and development of an aircraft, and have an impact upon the concept and detailed structural design, aerodynamic characteristics, weight.

8.4. International Initiatives

- Collaboration with Hassan Fathallah, Neuro-oncoly and mathematics, University of Alabama at Birmingham. We work on numerical modeling of brain tumor.
- Collaborations with Luca Zannetti, Politecnico di Torino; Simone Camarri, Universita di Pisa; Eyal Arian, Boeing Commercial Airplanes.
- PHC Sakura on cancer modeling with University of Osaka. (12Keur for 2 years) Collaboration with the University of Osaka on the modeling of the cell migration in cancer.
- Collaboration with John Ebos, Roswell Park Cancer Institute, Buffalo, NY, USA. Quantification of metastatic potential and differential effect of anti-angiogenenic therapies on primary tumor and metastasis, in a preclinical setting.
- Collaboration with the Center of Cancer and Systems Biology at Tufts University, Boston, MA, USA. We work together on quantitative modeling of tumor-tumor interactions and their implications on global metastatic dynamics.
- Collaboration with Sinisa Krajnovic, Chalmers University, on the high fidelity simulation and control of ground vehicle flows.
- Collaboration with Spencer Sherwin and Denis Doorly (Imperial College London) on the novel flow diagnostics approaches.

REALOPT Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Region Aquitaine is supporting a post-doc in our team. Jinil Han has been recruited to constribute to our team effort to develop efficient decomposition based approach to real-life combinatorial optimization problems. Jinil's research aims at enhancing performance of such approach and prepare the way to high performance computing through parallelisation. Jinil's mission extends to problem solving that serves both as a motivation and an proof-of-concept. Jinil has contributed so far to warm-starting the methods and to convergence accelaration through stabilization techniques [59]. Jinil has pushed the column generation for extented formlation method to the limit on the EDF application [58].

8.2. National Initiatives

Pierre Pesneau has got a grant from the OR research group from **CNRS** to finance mission between Bordeaux and Paris within the context of a collaboration with University Paris 6 (P. Fouilhoux) and University Paris 13 (S. Borne, R. Grappe, M. Lacroix). This collaboration aims to study polyhedral properties and algorithmic aspects to the problem of connected graph partitioning.

8.3. International Initiatives

8.3.1. Inria Associate Teams: SAMBA

Title: "Synergies for Ameliorations and Mastering of Branch-and-Price Algorithms"

International Partner (Institution - Laboratory - Researcher):

Pontificia Universidade Catolica do Rio de Janeiro (Brazil) - ATD-Lab - Marcus Poggi, and Universidade Federal Fluminense (UFF), Brazil - Eduardo Uchoa.

Duration: 2011 - 2013

See also: https://realopt.bordeaux.inria.fr/?page_id=573

The so-called Dantzig-Wolfe decomposition approach has not yet made its way into general purpose solvers for Mixed Integer Programming (MIP). Despite its proved efficiency, the use of the method is currently restricted to specific applications and requires ad-hoc algorithms developed by experts. Our project is to develop general purpose algorithms to make this method generic. We shall focus in particular on (i) preprocessing procedures, (ii) warm-starting, (iii) stabilization (to improve convergence), (iv) strategies for combining cut and column generation, and (v) primal heuristics. The project builds on the accumulated experience of both the Brazilian and the French teams that have done pioneering work in tackling complex applications and deriving generic solution strategies using this decomposition approach. The new algorithms are implemented and tested in the software platform BaPCod. Hence, the collaborative research on methodological developments should lead to, as a bi-product, a Version 2 of BaPCod as a state-of-the-art Branch-and-Price-and-Cut Solver. This prototype should (i) serve as proof-of-concept code for the research planned in thisproject and beyond, (ii) enable us to achieve new benchmark results on key problems,(iii) provide incentive for the use of the method by non experts, (iv) leverage technology transfer to industry.

8.3.2. Participation in other International Programs

- Collaboration with University of Minho through FCT Project MST4IRTO: New models and solution techniques for integrated and real-time optimization in the supply chain.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Eduardo Uchoa, Professor at Universidade Federal Fluminense (UFF), has visited the University Bordeaux for one month in April 2013.
- Hugo Kramer, PhD student at Universidade Federal Fluminense (UFF), is visiting the University Bordeaux for one year in 2013-2014.

8.4.1.1. Internships

- Silvia Ferretto, from the University of Padova (It) has done her Master intership with us from March until June.

8.4.2. Visits to International Teams

- Ruslan Sadykov visited the Universidade Federal Fluminense (UFF) for two weeks in March 2013.
- Francois Vanderbeck visited PUC-Rio and UFF for two weeks in March 2013.
- Francois Vanderbeck visited Marcos Goycoolea (Prof.), Operations Research and Complex Systems Group School of Business, Universidad Adolfo Ibañez, Chile, for 10 days in November 2013.

CARMEN Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- Project Modélisation pour les données multimodales (2012-2015) funded by the Conseil Regional Aquitaine. Coordinator J.-F. Aujol (Pr University Bordeaux 1). The PhD of G. ravon is funded within this project: 3D reconstruction by inverse problem in cardiac optical mapping.

8.2. National Initiatives

8.2.1. IHU LIRYC

Our work is partially funded by the LIRYC project (ANR 10-IAHU 04).

- For 2013: the salary of M. Potse, member of Carmen, is payed by the LIRYC.
- The LIRYC gives us a partial financial support. In 2013: support to go to the conference IEEE EMBC in Osaka, Japan (http://embc2013.embs.org), and partial support for a PhD jury.
- For 2012-2015: 1/2 PhD thesis associated to the project *Modélisation pour les données multimodales* (see section Regional Initiaves).

8.2.2. ANR HR-CEM

In 2013, we obtained a financial support for the project "High Resolution Cardiac Electrophysiology Models: HR-CEM" within the call for project « Modèles Numériques » of the ANR.

The scientific start of the project was on November, 4th, 2013.

It is an international project that involves three partners, Inria (coordinator), IHU LIRYC, and UMI-CRM at Montréal (Canada). The project has some external collaborators in Univ. Nantes, Univ. Pau and BCAM (Basque Center for Applied Math) at Bilbao (Spain).

Based on these collaborations and new developments in structural and functional imaging of the heart available at LIRYC, we plan to reconsider the concepts behind the models in order to improve the accuracy and efficiency of simulations. Cardiac simulation software and high-resolution numerical models will be derived from experimental data from animal models. Validation will be performed by comparing of simulation output with experimentally recorded functional data. The validated numerical models will be made available to the community of researchers that take advantage of in-silico cardiac simulation and, hopefully, become references. In particular we shall provide the first exhaustive model of an animal heart including the four chambers coupled through the special conduction network, with highly detailed microstructure of both the atria and the ventricles. Such a model embedded in high-performance computational software will provide stronger medical foundations for in-silico experimentation, and elucidate mechanisms of cardiac arrhythmias.

8.2.3. AMIES – Medic Activ

We were granted by the Agency AMIES a financial support to complete the one obtained from the Région Aquitaine for the Medic Activ project (see above). The objective of this support is to developp reduced order models of cardiac electrophysiology that might enter the MedicActiv framework. The difficulty is to define qualitatively realistic but fast numerical simulations of the ECG and cardiac function, for educational purpose.

8.2.4. ANR Labcom CardioXcomp

We are participant in the ANR Labcom project between Inria and the society Notocord (www.notocord.com). At Inria, the proejct is leaded by JF. Gerbeau from the Reo team and we participate to the study and developpment of cardiac electrophysiology models suited to the context of the proejct.

The project is in its starting phase in 2013: the objective of the first 6 months is to define precisely the nature and objectives of the common laboratory between Inria and Notocord. A contract is planned to be signed after these 6 months, and the ANR financial support to be granted at that time.

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations

Partner 1: Computational Biology Group, Department of Computer Science, Oxford University (United Kingdom).

Our work with the computational biology group concerns the development of multi-scale models of the drugs and their effect on the electrical activity of the heart. The main goal is to assess the drug-induced effects on the electrocardiogram, using a computational model describing the physiology from ion channel to body surface potentials.

Partner 2: BCAM (Basque Center for Applied Mathematics), Bilbao (Spain).

We collaborate with L. Gerardo Giorda, research fellow at the BCAM on: the development of our new sopftware CEPS, the design and study of new domain decomposition methods suited to our cardiac electrophysiology models, the evaluation of some sensitivity analysis issues in cardiac electrophysiology.

Partner 3: Department of Experimental Cardiology, Academic Medical Center, University of Amsterdam (Netherland).

With the groups of Pr J. de Bakker and of Dr R. Coronel, we work on the arythmias related to degradations of the tissues (due to aging or cardiomyopathies), combined with diseases of the ionic channels, qsuch as the Brugada syndrome.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal International Partners

- Collaboration with the Pr. Y. Bourgault (http://aix1.uottawa.ca/ ybourg/personal.html) from the department of Mathematics and statistics of the University of Ottawa (Canada).

  Subject: models and numerical methods for cardiac electrophysiology.

  Support: This collaboration has been supported by the ANR project Momme (ANR-JCJC-07-0141), the Region des Pays de la Loire and the Natural Sciences and Engineering of Research council of Canada (NSERC). From 2013, it is supported by the ANR project HR-CEM. Y. Bourgault had an "invited researcher" position at Inria for two months for October and November, 2013.

8.4.2. Inria International Labs

- LIRIMA: Equipe Problèmes Inverses et Contrôle (EPIC), University Tunis Al Manar et Laboratoire de Modélisation Mathématique et Numérique dans les Sciences de l'Ingénieur (LAMSIN), Tunisia.

  The EPIC team has an important experience in dealing with ill-posed inverse problems for static and evolution problems. The goal of this collaboration is to apply the methods developed in this team to inverse problems in electrocardiography.

  This collaboration is mainly supported by the international laboratory LIRIMA.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Y. Bourgault, Pr. University of Ottawa, Department of mathematics and statistics. Invited researcher for 2 months, 1/10/2013 to 30/11/2013.

  Comparison between the monodomain and bidomain models for cardiac electrophysiology, and design of an optimalmonodomain aprroximation of the nidomain equations.
- In July, 2013, B. Smaill, Professor at the Auckland Bioengineering Institute (ABI) and leader of the Cardiac Electrophysiology group, and M. Nash, Professor and Associate Director of the ABI, visited the LIRYC Institute, including a visit to our team Carmen and rich exchanges about our approaches of modelling and the role of experimental data.
- Mohamed Jebalia, Assistant professor, ENIT (Tunisia), researcher from the LAMSIN, May toJuly 2013.

8.5.1.1. Internships – Visiting PhD Students

- Mohammed Addouche, March 2013.

  Institution: University of Tlemcen (Algeria)

  Subject: On using factorisation methods for the quasistatic inverse problems of electrocardiology.
- Najib Fiakl, PhD student, December 2013.

  Institution: University of Rabat (Morroco)

  Subject: Study of the uncertainties on the thoracic electrical conductivities on the resolution of the direct problem of electrocardiology.
- Wajih Mbarki, November to December 2013.

  Institution: Université El Manar of Tunis, Tunisia

  Subject: Theoretical and numerical study of the Purkinje-muscle coupling in cardiac electrophysiology.
- Jamila Lassoued, September 2013.

  Institution: ENIT of Tunis, Tunisia

  Subject: application of model reduction techniques to the inverse problems in cardiac electrophysiology.
- Laura Bear, October to December 2013, was co-localized between the LIRYC and Inria.

  Institution: University of Auckland (New Zealand), Auckland Bioengineering Institute

  Subject: Laura started to work on our inverse solutions for the cardiac electrical imaging problem using the datasets obtained during the first two years of her PhD at the Auckland Bioengineering Institute. The objective is to investigate the possibility and limitations of cardiac non-invasive electrical imaging.

8.5.1.2. Internships

- Hamed Bourenane, July to August 2013

  Institution: Student in medicine at the University Bordeaux Segalen

  Subject: Segmentations of CT-scan images from the CardioInsight system including fat, bones, lungs, etc.
- Valentin heisel, June to September 2013

  Institution: ENSEIRB-MATMECA

  Subject: Developped a fortran module to account for 2nd order solvers in cardiac electrophysiology and compared various solvers for cellular electrophysiology.
- Nina Le Devehat, June to July 2013

  Institution: First year of University Bordeaux I, supported by the programme “stages d’excellence” from the University

Subject: She studied the modelling of cellulat electrophysiology by the Vanderpol equations.

- Abdessamad Sobhi, July to September 2013

  Institution: ENSEIRB-MATMECA

  Subject: Inverse problem of cardiac electrophysiology.

- Thibaut Vandromme, June to September 2013

  Institution: ENSEIRB-MATMECA

  Subject: Fast solvers for cardiac electrophysiology, continued the work in SOFA of a previous trainee (N. Claude in 2012).

- Bastien Verot, June to September 2013

  Institution: ENSEIRB-MATMECA

  Subject: Numerical approximation of the microscopic bidomain equations of cardiac electrophysiology in a simplified linear context.

- Mathias Cassonnet, January 2013

  Institution: secondary school pupil

  Subject: Trainee for observation only

- Alexandre Lourenco Peirera, January 2013

  Institution: secondary school pupil

  Subject: Trainee for observation only

8.5.2. Visits to International Teams

- Y. Coudière visited the GIREF (« Groupe Interdisciplinaire de Recherche en Éléments Finis »), June, 2013.

MAGIQUE-3D Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

The PhD fellowship of Elodie Estecahandy is partially (50%) funded by the Conseil Régional d'Aquitaine.

The PhD fellowship of Vanessa Mattesi is partially (50%) funded by the Conseil Régional d'Aquitaine.

The Post-Doctoral fellowship of Juliette Chabassier is partially (50%) funded by the Conseil Général des Pyrénées Atlantiques.

The Post-Doctoral fellowship of Ángel Rodríguez Rozas is partially (50%) funded by the Conseil Régional d'Aquitaine.

8.2. National Initiatives

8.2.1. Depth Imaging Partnership

Magique-3D maintains active collaborations with Total. In the context of Depth Imaging, Magique-3D coordinates research activities dealing with the development of high-performance numerical methods for solving wave equations in complex media. This project involves 2 other Inria Team-Projects (Hiepacs and Nachos) which have complementary skills in mathematics, computing and in geophysics. DIP is fully funded by Total by the way of an outline agreement wit Inria .

Since its beginning (2009), eight PhD students have been funded and Magique 3D has hired six of them, one being shared with the project team Nachos (http://www-sop.inria.fr/nachos/). Moreover, several internships have been realized. 2013 was a particular year for the project because Total decided to extent DIP for five years. It has been necessary to update the legal framework of the project which explains that the second phase of DIP will officially begin in 2014. Nevertheless, in order to preserve the dynamic of the project, Magique-3D has hired an internship, Wilfredo Salazar, coming from the Engineering school INSA at Rouen.

8.2.2. Micro-local analysis of wave equations

The numerical solution of wave equations most often requires to truncate the propagation domain to define a computational domain limited by an artificial boundary. Magique-3D is very involved in the construction and mathematical validation of boundary conditions which are set on the artificial boundary. Different techniques can be used for the design of such conditions and Magique-3D maintains a collaboration with Prof. Olivier Lafitte from the University of Paris 13 on the mathematical analysis of the Dirichlet-to-Neumann (DtN) operator for acoustic waves. This issue is addressed by applying micro-local analysis which enables us to consider the full DtN operator in the whole space of frequencies.

8.2.3. Partnership with the department DMAE of ONERA

title: Modeling of multiperforated plates

Coordinator: Sébastien Tordeux

Other partners: Department DMAE of ONERA

Abstract: In the aeronautic industry, there is a need of numerical models for the design of turboreactors of new generation. Magique-3D is cooperating with the department DMAE of ONERA to develop acoustic models of multiperforated plates which is an important component of the turboreactors.

This project is interdisciplinary, since it involves the experimental expertise of Estelle Piot (acoustician engineer of ONERA working on acoustic bench), the competences in mathematical modeling of Magique 3D. In parallel to the obtention of new theoretical results we are jointly developing a new

numerical library based on the discontinuous Galerkin approximation which aims in interpreting experimental data.

This cooperation is formalized thanks to the common supervision of the PhD of Vincent Popie funded by ONERA and DGA and is a follow-up of the ANR APAM (2008-2011).

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. HPC-GA

Title: High Performance Computing for Geophysics Applications

Type: PEOPLE

Instrument: International Research Staff Exchange Scheme (IRSES)

Duration: January 2012 - December 2014

Coordinator: Inria (France)

Others partners: BCAM (Basque Center of Applied Mathematics), Spain; BRGM (Bureau de Recherches Géologiques et Minières), France; ISTerre (Institut des Sciences de la Terre, France; UFRGS (Federal University of Rio Grande do Sul), Institute of Informatics, Brazil; UNAM (National Autonomous University of Mexico) , Institute of Geophysics, Mexico;

See also: https://project.inria.fr/HPC-GA/en

Abstract: Simulating large-scale geophysics phenomenon represents, more than ever, a major concern for our society. Recent seismic activity worldwide has shown how crucial it is to enhance our understanding of the impact of earthquakes. Numerical modeling of seismic 3D waves obviously requires highly specific research efforts in geophysics and applied mathematics, leveraging a mix of various schemes such as spectral elements, high-order finite differences or finite elements.

But designing and porting geophysics applications on top of nowadays supercomputers also requires a strong expertise in parallel programming and the use of appropriate runtime systems able to efficiently deal with heterogeneous architectures featuring many-core nodes typically equipped with GPU accelerators. The HPC-GA project aims at evaluating the functionalities provided by current runtime systems in order to point out their limitations. It also aims at designing new methods and mechanisms for an efficient scheduling of processes/threads and a clever data distribution on such platforms.

The HPC-GA project is unique in gathering an international, multidisciplinary consortium of leading European and South American researchers featuring complementary expertise to face the challenge of designing high performance geophysics simulations for parallel architectures: UFRGS, Inria, BCAM and UNAM. Results of this project will be validated using data collected from real sensor networks. Results will be widely disseminated through high-quality publications, workshops and summer-schools.

Three members of MAGIQUE-3D (Julien Diaz, Victor Péron and Angel Rodríguez Rozas) participated to the second Workshop of HPC-GA in Bilbao on March 11th-15th, 2013, http://www.bcamath.org/en/workshops/second-workshop-of-the-hpc-ga-project.

Manuela Longoni de Castro, Assistant Professor at UFRGS, spent one month in MAGIQUE-3D in January 2013.

8.3.2. Collaborations in European Programs, except FP7

8.3.2.1. AKELARRE

Joint project with BCAM (Basque Center of Applied Mathematics) funded by the Conseil Régional d'Aquitaine and the Basque Government in the framework of the Aquitaine-Euskadi Call. Total Amount: 14 000 euros.

Program: Fonds commun de coopération Aquitaine/Euskadi

Project acronym: AKELARRE

Project title: Méthodes numériques innovantes et logiciels performants pour la simulation de la propagation des ondes électromagnétiques en milieux complexes

Duration: février 2011 - février 2013

Coordinator: Hélène Barucq

Other partners: BCAM (Basque Center of Applied Mathematics), Spain

Abstract: This project brings together complementary skills of two research teams which are respectively located in Pau and Bilbao. The main objective of this collaboration is to develop innovative numerical methods in the field of wave propagation and to implement powerful software for the simulation of electromagnetic waves in complex media. These waves play an important role in many industrial applications and the development of such software is of great interest for many industrial enterprises located in the region. Theoretical and practical issues are considered. In particular, we focus on the mathematical analysis of boundary conditions that play a crucial role for accurate numerical simulations of waves.

8.3.2.2. Procope Inria - TU Berlin

Joint project with the Matheon Research Center in Berlin funded by the European Union in the framework of the Procope 2012 Call. Total Amount: 2800 euros.

Program: PHC Procope 2012

Project acronym: Procope Inria - TU Berlin

Project title: Procope Inria - TU Berlin

Duration: January 2012 - December 2013

Coordinator: Sébastien Tordeux

Other partners: Matheon Research Center, TU Berlin, Germany

Abstract: This project aims in funding trips between Pau and Berlin. The young research group of Kersten Schmidt and Magique 3D are both specialist of the modeling and the simulation of the wave propagation phenomena. During this program we focus on the modeling of multiperforate plates which are present in the combustion chambers; on the derivation of absorbing boundary conditions for stratified media and on the development of precise numerical methods in the context of the Hardy problem.

In this framework several members of Magique 3D visited the Matheon Research Center in Berlin :

- Julien Diaz, May 7th to May 10th
- Victor Péron spent one week in Berlin in November
- Juliette Chabassier spent one month in Berlin

and several members of Matheon Research Center visited Magique 3D :

- Kersten Schmidt spent one week in Pau in November
- Robert Gruhlke spent one week in Pau in November
- Philipp Kliewe spent one week in Pau in November
- Dirk Klindworth spent one week in Pau in December
- Maxim Zeinaliyev spent two weeks in Pau in December

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. MAGIC

Program: Inria International Partner

Title: Advance Modelling in Geophysics

Inria principal investigator: Hélène Barucq

International Partner (Institution - Laboratory - Researcher):

California State University at Northridge (United States) - Department of Mathematics - Rabia Djellouli

The Associated Team MAGIC was created in January 2006 and renewed in January 2009. At the end of the program in December 2011, the two partners, MAGIQUE-3D and the California State University at Northridge (CSUN). decided to continue their collaboration and obtained the "Inria International Partner" label in 2013.

See also: https://project.inria.fr/magic/

The ultimate objective of this research collaboration is to develop efficient solution methodologies for solving inverse problems arising in various applications such as geophysical exploration, underwater acoustics, and electromagnetics. To this end, the research program will be based upon the following three pillars that are the key ingredients for successfully solving inverse obstacle problems: 1) The design of efficient methods for solving high-frequency wave problems. 2) The sensitivity analysis of the scattered field to the shape and parameters of heterogeneities/scatterers. 3) The construction of higher-order Absorbing Boundary Conditions.

Élodie Estécahandy defended her PhD thesis, *Contribution à l'analyse mathématique et à la résolution numérique d'un problème inverse de scattering élasto-acoustique*, on September 19th 2013. She has been coadvised by Hélène Barucq and Rabia Djellouli in the framework of MAGIC.

Rabia Djellouli visited MAGIQUE-3D in September 2013.

8.4.2. Participation In other International Programs

8.4.2.1. HOSCAR

Program: Inria-CNPq

Title: High performance cOmputing and SCientific dAta management dRiven by highly demanding applications

Inria principal investigator: Stéphane Lanteri (Nachos, Inria Sophia Antipolis-Méditerranée

International Partners:

LNCC (Laboratório Nacional de Computação Científica), Brazil;

COPPE/UFRJ (Instituto Alberto Luiz Coimbra de Pós-Graduação e Pesquisa de Engenharia/Alberto Luiz Coimbra Institute for Grad<uate Studies and Research in Engineering, Universidade Federal do Rio de Janeiro), Brazil;

INF/UFRGS (Instituto de Informática, Universidade Federal do Rio Grande do Sul);

LIA/UFC (Laboratórios de Pesquisa em Ciência da Computação Departamento de Computação, Universidade Federal do Ceará).

Inria Teams :

NACHOS, Inria Sophia Antipolis - Méditerranée;

ZENITH, Inria Sophia Antipolis - Méditerranée;

MOAIS, Inria Grenoble - Rhone-Alpes;

HIEPACS, Inria Bordeaux - Sud-Ouest;

MOAIS, Inria Bordeaux - Sud-Ouest;

MAGIQUE 3D, Inria Bordeaux - Sud-Ouest;

Duration: 2012-2015

See also: http://www-sop.inria.fr/hoscar/

HOSCAR is a CNPq - Inria collaborative project between Brazilian and French researchers, in the field of computational sciences, also sponsored by the French Embassy in Brazil. It is coordinated by the team-project Nachos

The general objective of the project is to setup a multidisciplinary Brazil-France collaborative effort for taking full benefits of future high-performance massively parallel architectures. The targets are the very large-scale datasets and numerical simulations relevant to a selected set of applications in natural sciences: (i) resource prospection, (ii) reservoir simulation, (iii) ecological modeling, (iv) astronomy data management, and (v) simulation data management. The project involves computer scientists and numerical mathematicians divided in 3 fundamental research groups: (i) numerical schemes for PDE models, (ii) scientific data management, and (iii) high-performance software systems. Several Brazilian institutions are participating to the project among which: LNCC (Laboratório Nacional de Computaçäo Científica), COPPE/UFRJ (Instituto Alberto Luiz Coimbra de Pós-Graduaçäo e Pesquisa de Engenharia/Alberto Luiz Coimbra Institute for Grad<uate Studies and Research in Engineering, Universidade Federal do Rio de Janeiro), INF/UFRGS (Instituto de Informática, Universidade Federal do Rio Grande do Sul) and LIA/UFC (Laboratórios de Pesquisa em Ciência da Computaçäo Departamento de Computaçäo, Universidade Federal do Ceará). The French partners are research teams from several Inria research centers. MAGIQUE-3D is involved by the way of its research activities on finite element approximations which can be used for resource prospection and reservoir simulation. Several members of MAGIQUE-3D participated to the third workshop of the project in Bordeaux, Sep 2nd to 6th 2013 [69], [46], [60], [78]. In the framework of HOSCAR, Théophile Chaumont-Frelet who is a PhD student in Magique-3D, spent two weeks in August 2013 at the LNCC to initiate a collaboration with Prof. F. Valentin on the development of new finite element methods for the Helmholtz equation.

8.4.2.2. GEO3D

Program: Inria-Russia

Title: Models and numerical simulations in Geosciences: wave propagation in complex media

Inria principal investigator: Sébastien Tordeux

International Partner (Institution - Laboratory - Researcher):

Novosibirsk State University (Russia (Russian Federation)) - Institute of Numerical Mathematics and Mathematical Geophysics - Sébastien Tordeux

Duration: January 2012 - December 2014

See also: http://uppa-inria.univ-pau.fr/m3d/ConfFR/participants.html

GEO3D is a collaborative project between Magique 3D team-project (Inria Bordeaux Sud-Ouest) and the Institute of Numerical Mathematics and Mathematical Geophysics (Novosibirsk State University) and the Institute of Petroleum Geology and Geophysics, of in the context of geosciences.

We are mainly interested in the derivation of numerical methods (discontinuous Galerkin approximation, space-time refinement), the design of direct and inverse high performance solver, and the modeling of complex media.

More precisely, we are actually interested

1. in the computation of truncated Singular Value decomposition of very large matrix to analyze the inverse problem;
2. in the coupling of a discontinuous Galerkin method with a finite differences method for the direct problem;
3. in a spectral time stepping method for the direct problem;
4. in an algorithm to determine an impedance coefficient using indirect measurement.

Several researchers from the Institutes of Novosibirsk visited MAGIQUE-3D in 2013

- Serguey Kabanikhin spent one week in June 2013
- Maxim Shishlenin spent one month in June 2013 as invited Professor
- Vadim Lisitsa spent one month in September 2013
- Vladimir Tcheverda spent one month in September 2013

Several researchers from MAGIQUE-3D visited the Institute of Numerical Mathematics and Mathematical Geophysics in 2013

- Julien Diaz spent two weeks in February 2013
- Vanessa Mattesi spent three weeks in February 2013
- Sébastien Tordeux spent three weeks in February 2013
- Sébastien Tordeux spent two weeks in February 2013
- Vincent Popie spent two weeks in October 2013

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Patrick Dular (Université de Liège) spent two months MAGIQUE-3D between January 2013 and April 2013 as invited Professor.
- Manuela Longoni de Castro, Assistant Professor at UFRGS, spent one month in MAGIQUE-3D in January 2013.
- Serguey Kabanikhin spent one week in June 2013
- Maxim Shishlenin spent one month in June 2013 as invited Professor
- Vadim Lisitsa, Assistant Professor at Novossibirsk State University, spent one month in MAGIQUE-3D in September 2013.
- Vladimir Tcheverda, Professor at Novossibirsk State University, spent one month in MAGIQUE-3D in September 2013.

MAGNOME Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Aquitaine Region "SAGESS" comparative genomics for wine starters.

This project is a collaboration between the company BioLaffort, specialized in the selection of industrial yeasts with distinct technological abilities, with the ISVV and MAGNOME. The goal is to use genome analysis to identify molecular markers responsible for different physiological capabilities, as a tool for selecting yeasts and bacteria for wine fermentation through efficient hybridization and selection strategies. This collaboration has obtained the INNOVIN label.

8.2. National Initiatives

8.2.1. ANR MYKIMUN.

Signal Transduction Associated with Numerous Domains (STAND) proteins play a central role in vegetative incompatibility (VI) in fungi. STAND proteins act as molecular switches, changing from closed inactive conformation to open active conformation upon binding of the proper ligand. Mykimun, coordinated by Mathieu Paoletti of the IBGC (Bordeaux), studies the postulated involvement of STAND proteins in heterospecific non self recognition (innate immune response).

In MYKIMUN we extend the notion of fungal immune receptors and immune reaction beyond the *P. anserina* NWD gene family. We develop *in silico* machine learning tools to identify new potential PRRs based on the expected characteristics of such genes, in *P. anserina* and beyond in additional sequenced fungal genomes. This should contribute to extend concept of a fungal immune system to the whole fungal branch of the eukaryote phylogenetic tree.

8.3. European Initiatives

8.3.1. FP7 Projects

A major objective of the "post-genome" era is to detect, quantify and characterise all relevant human proteins in tissues and fluids in health and disease. This effort requires a comprehensive, characterised and standardised collection of specific ligand binding reagents, including antibodies, the most widely used such reagents, as well as novel protein scaffolds and nucleic acid aptamers. Currently there is no pan-European platform to coordinate systematic development, resource management and quality control for these important reagents.

MAGNOME is an associate partner of the FP7 "Affinity Proteome" project coordinated by Prof. Mike Taussig of the Babraham Institute and Cambridge University. Within the consortium, we participate in defining community for data representation and exchange, and evaluate knowledge engineering tools for affinity proteomics data.

8.3.2. Collaborations with Major European Organizations

Prof. Mike Taussig: Babraham Institute & Cambridge University
Knowledge engineering for Affinity Proteomics
Henning Hermjakob: European Bioinformatics Institute
Standards and databases for molecular interactions

8.4. International Initiatives

8.4.1. Inria Associate Teams

MAGNOME participates in the CARNAGE associated team, coordinated by AMIB, with the Russian Academy of Sciences.

8.4.2. Inria International Partners

8.4.2.1. Declared Inria International Partners

AMAVI

Program: Inria International Partner

Title: Combinatorics and Algorithms for the Genomic sequences

Inria principal investigators: David Sherman

International Partner (Institution - Laboratory - Researcher):

Vavilov Institute of General Genetics (Russia (Russian Federation)) - Department of Computational Biology - Vsevolod Makeev

Duration: 2010 - present

VIGG and AMIB teams has a more than 12 years long collaboration on sequence analysis. The two groups aim at identifying DNA motifs for a functional annotation, with a special focus on conserved regulatory regions. In the current 3-years project CARNAGE, our collaboration, that includes Inrai-team MAGNOME, is oriented towards new trends that arise from Next Generation Sequencing data. Combinatorial issues in genome assembly are addressed. RNA structure and interactions are also studied.

The toolkit is pattern matching algorithms and analytic combinatorics, leading to common software.

8.4.2.2. Informal International Partners

MAGNOME collaborates with Rodrigo Assar of the Universidad Andrès Bello, and Nicolás Loira and Alessandro Maass of the Center for Genomic Regulation, in Santiago de Chile (Chile).

8.4.3. Participation in other International Programs

MAGNOME and the VIGG of the Russian Academy of Sciences (RAS) in Moscow are partners in a project funded by the CNRS and the RAS entitle “Séquençage profond de organismes biotechnologiques : des régulons à l’adaptation ”.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Vsevolod MAKEEV November 8-22 2013

Artëm KASIANOV November 8-22 2013

8.5.1.1. Internships

Joaquin FERNANDEZ September-November 2013

MNEMOSYNE Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

7.1.1.1. ANR project KEOPS

Participants: Frédéric Alexandre, Thierry Viéville.

We are responsible for this "ANR Internal White Project" involving Mnemosyne and Neuromathcomp Inria Project-Teams in France with the U. of Valparaiso, U. Tecnica Frederico Santa-Maria, and U. Chile. The project addresses the integration of non-standard behaviors of retinal neural sensors, observed in natural conditions, into neural coding models and their translation into real, highly non-linear, bio-engineering artificial solutions. This project is now a four year project untill the end of 2014, it has been evaluated by the reviewers at the end of 2013. Results concerning the thalamus and the retina evoked in § 6.3 and § 6.4 have been obtained in this project. Furthermore, new collaboration tracks have been conducted, taking benefit of interdisciplinarity of this international collaboration, e.g. at the methodological level [1].

7.2. International Initiatives

7.2.1. Inria Associate Teams

7.2.1.1. Cortina, associate team with Chile

Participants: Frédéric Alexandre, Thierry Viéville.

The goal of this associate team that finished this year is to combine our complementary expertise, from experimental biology and mathematical models (U de Valparaiso and U Federico Santa-Maria) to computational neuroscience (Mnemosyne and Neuromathcomp Project-teams), 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.

7.2.2. Inria International Partners

7.2.2.1. Informal International Partners

We have informal relations with the Computational Cognitive Neuroscience (CCN) Lab, University of Colorado, Boulder, USA (Prof. Randall O'Reilly) concerning the computationally-based understanding of the neural circuits involved in affectively-driven decision making, including the basal ganglia (BG) and ventral and medial prefrontal cortex areas.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

7.3.1.1. Invited Professor

Prof. Adrian Palacios, responsible for the chilean part of our associate team Cortina (*cf.* § 7.2) has been visiting Bordeaux one month in September 2013. He was also partly supported by the Labex BRAIN.

7.3.1.2. Internships

Meropi Topalidou

Subject: Touch and the Body

Date: from Mar 2013 until Sep 2013

Institution: Université Nationale Capodistrienne d'Athènes (Greece)

Román Gorojovsky

Subject: Hierachical Associative Memories

Date: from Apr 2013 until Oct 2013

Institution: University of Buenos Aires (Argentina)

7.3.2. Visits to International Teams

From mid-july to end of August, Maxime Carrere, a newly-hired PhD student in the team, has visited the CCN lab in Boulder, USA (*cf.* § 7.2) for 6 weeks.

CEPAGE Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

- **ANR ALADDIN** (Algorithm Design and Analysis for Implicitly and Incompletely Defined Interaction Networks; GANG and CEPAGE project-teams): the members of Cepage have been participating to the ANR project "blanc" (i.e. fundamental research) about the fundamental aspects of large interaction networks enabling massive distributed storage, efficient decentralized information retrieval, quick inter-user exchanges, and/or rapid information dissemination. The project is mostly oriented towards the design and analysis of algorithms for these (logical) networks, by taking into account proper ties inherent to the underlying infrastructures upon which they are built. The infrastructures and/or overlays considered in this project are selected from different contexts, including communication networks (from Internet to sensor networks), and societal networks (from the Web to P2P networks).
- **ANR SONGS** (Simulation of Next Generation Systems; participants: AlGorille (LORIA, Nancy), MESCAL (Grenoble), GRAAL (ENS Lyon), IN2P3 (Lyon), CEPAGE, HiePACS, RUNTIME (Bordeaux), LSIIT (Strasbourg), ASCOLA (Nantes), MASCOTTE, MODALIS (Sophia Antipolis)). This project started in 2012 as a follow-up of the USS-SIMGRID project. The aim is to further extend the domain of SimGrid, by designing a unified simulation framework for the four application domains: Grids, Peer-to-Peer systems, High Performance Computing, and Cloud systems. Achieving this goal mandates careful representation and modeling of the underlying concepts presented by each domain (memory, disks, energy, network and volatility) and of the interfaces specific to each domain. It also requires a transversal work on the simulation framework itself. CEPAGE is actively involved in this project, both for the peer-to-peer use cases and for the coordination of the modeling effort of the project.
- **ANR Displexity** (Calcul DIStribué: calculabilité et comPLEXITé; participants: CEPAGE, GANG and ASAP projects). The main goal of DISPLEXITY is to establish the scientific foundations of a theory of calculability and complexity for distributed computing. Displexity started in 2012.
- **ANR IDEA** ANR program “defis”: project IDEA (2009-2012). The goal of this ANR is the study of identifying codes in evolving graphs. Ralf Klasing is the overall leader of the project.
- **ANR “Jeunes chercheurs” EGOS - Embedded Graphs and their Oriented Structures** (2012-2014) (see http://www.lirmm.fr/egos/)

  Participants: CEPAGE/LaBRI(Bordeaux) LIRMM(Montpellier), LIX(Palaiseau) The goal of this project is the study oriented structures on graphs of arbitrary genus.
- **AMADEUS** (CNRS funding on “BIG DATA”: 2012-): Analysis of MAssive Data in Earth and Universe Sciences. This a multidisciplinary research project between computer science teams (LIRMM: University of Montpellier, LIF: University of Marseille) and CEPAGE), earth and climate science (CEREGE: Montpellier and IRD: Aix) and astronomy (LAM: University of Marseille). The aim of the project is to propose effective techniques for mining large data by essentially using distributed computing, visualization, summarization and approximation.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. EULER

EULER

- Title: EULER (Experimental UpdateLess Evolutive Routing)
- Type: COOPERATION (ICT)
- Defi: Future Internet Experimental Facility and Experimentally-driven Research
- Instrument: Specific Targeted Research Project (STREP)
- Duration: October 2010 - September 2013
- Coordinator: ALCATEL-LUCENT (Belgium)
- Others partners:
  Alcatel-Lucent Bell, Antwerpen, Belgium
  3 projects from Inria: CEPAGE, GANG and MASCOTTE, France
  Interdisciplinary Institute for Broadband Technology (IBBT),Belgium
  Laboratoire d'Informatique de Paris 6 (LIP6), UniversitÃÂ© Pierre Marie Curie (UPMC), France
  Department of Mathematical Engineering (INMA) UniversitÃÂ© Catholique de Louvain, Belgium
  RACTI, Research Academic Computer Technology Institute University of Patras, Greece
  CAT, Catalan Consortium: Universitat Politecnica de Catalunya, Barcelona and University of Girona, Spain
- See also: http://www-sop.inria.fr/mascotte/EULER/wiki/
- Abstract: The title of this study is "Dynamic Compact Routing Scheme". The aim of this projet is to develop new routing schemes achieving better performances than current BGP protocols. The problems faced by the inter-domain routing protocol of the Internet are numerous:

  The underlying network is dynamic: many observations of bad configurations show the instability of BGP;

  BGP does not scale well: the convergence time toward a legal configuration is too long, the size of routing tables is proportional to the number of nodes of network (the network size is multiplied by 1.25 each year);

  The impact of the policies is so important that the many packets can oscillated between two Autonomous Systems.

  In this collaboration, we mainly focus on the scalability properties that a new routing protocol should guarantee. The main measures are the size of the local routing tables, and the time (or message complexity) to update or to generate such tables. The design of schemes achieving sub-linear space per routers, say in n where n is the number of AS routers, is the main challenge. The target networks are AS-network like with more than 100,000 nodes. This projet, in collaboration with the MASCOTE Inria-project in Nice Sophia-Antipolis, makes the use of simulation, developed at both sites.

7.2.2. Collaborations in European Programs, except FP7

- Program: European COST
- Project acronym: Complex HPC IC0805.
- Project title: Open Network for High-Performance Computing on Complex Environments
- Duration: 2010-2013
- Coordinator: Inria
- Other partners: 26 countries, see list at http://www.cost.eu/domains_actions/ict/Actions/IC0805?parties
- Abstract: The main objective of this COST action is to coordinate European groups working on the use of heterogeneous and hierarchical systems for HPC as well as the development of collaborative activities among the involved research groups (http://complexhpc.org/index.php).

7.3. International Initiatives

7.3.1. Inria International Partners

- **Royal Society Grant with the University of Liverpool.** International Joint Project, 2011-2013, entitled "SEarch, RENdezvous and Explore (SERENE)", on foundations of mobile agent computing, in collaboration with the Department of Computer Science, University of Liverpool. Funded by the Royal Society, U.K. Principal investigator on the UK side: Leszek Gasieniec. Ralf Klasing is the principal investigator on the French side.

  Participants: Nicolas Hanusse, David Ilcinkas, Ralf Klasing, Adrian Kosowski.

- **Spanish program CLOUDS**: Cloud Computing for Scalable, Reliable and Ubiquitous Services (http://lsd.ls.fi.upm.es/clouds). This is a large scale program which aims at advancing research in the area of Cloud Computing. CEPAGE is more particularly in contact with the LaDyr team of Univ. Rey Juan Carlos in Madrid, on the topic of resource allocation problems for Cloud providers.

  Participants: Olivier Beaumont, Lionel Eyraud-Dubois.

- **Collaboration with Canada.**

  Members of CEPAGE have a long-standing collaboration with researchers from the Chair of Distributed Computing at the University of Quebec in Outaouais and the Department of Computer Science at Carleton University. Sources of financing include: personal NSERC grants of Canadian professors (Prof. Andrzej Pelc, Prof. Jurek Czyzowicz, Prof. Evangelos Kranakis), funding from other Canadian grant agencies (a travel grant from Mitacs Inc.), and University of Bordeaux funding (a 3-month invited professorship for Prof. Jurek Czyzowicz).

  Participants: David Ilcinkas, Ralf Klasing, Adrian Kosowski.

- **Collaboration with Chile.**

  Adrian Kosowski is a foreign partner of the Chilean ministry grant (ANILLO CONICYT programme) entitled "Mathematical modeling for industrial and management science applications: a multidisciplinary approach". The Project Director is Eric Goles from Universidad Adolfo Ibañez, and collaborating researchers on the Chilean side include Karol Suchan and Ivan Rappaport. The collaboration has led to 2 joint papers.

  Participants: Adrian Kosowski.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Tomasz Radzik, King's College London, UK, 02/12-06/12/2013

Miroslaw Korzeniowski, TU Wroclaw, Poland, 09/13-10/2013

Petra Berenbrink, Simon Fraser University, Burnaby, Canada, 22/10-26/10/2013

Joseph G. Peters, Simon Fraser University, Burnaby, Canada (Invited professor Bdx1) 24/01-24/02/2013

Carlos Ordonez, the University of Houston, USA (06-07/2013) supported by CNRS.

Dariusz Dereniowski, Gdansk University of Technology, Poland, 26/04-31/05/2013

Lukasz Kuszner, Gdansk University of Technology, Poland, 24/04-02/06/2013

Marcin Markiewicz, University of Gdansk, Poland, 02/09-15/09/2013

Leszek Gasieniec, University of Liverpool, UK, 24/09-27/09/2013

Jakub Lacki, University of Warsaw, Poland, 25/11-30/11/2013

Przemyslaw Uznanski, Universite de Marseille, France, 25/11-30/11/2013

7.4.1.1. Internships

Siddharth Mandal

Subject: Reliability Issues in Cloud Computing

Date: from May 2013 until Jul 2013

Institution: IIT Delhi (India)

Rohit Kumar

Subject: Robust Dynamic Allocation in Cloud Computing

Date: from May 2013 until Aug 2013

Institution: IIT Delhi (India)

HIEPACS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. PlaFRIM: an experimental parallel computing platform

PlaFRIM is an experimental platforme for research in modeling, simulations and high performance computing. This platform has been set up from 2009 under the leadership of Inria Bordeaux Sud-Ouest in collaboration with computer science and mathematics aboratories, respectively Labri and IMB with a strong support in the region Aquitaine.

It aggregates different kinds of computational resources for research and development purposes. The latest technologies in terms of processors, memories and architecture are added when they are available on the market. It is now more than 1,000 cores (excluding GPU and Xeon Phi) that are available for all research teams of Inria Bordeaux, Labri and IMB. This computer is in particular used by all the engineers who work in HiePACS and are advised by F. Rue from the SED.

The PlaFRIM platform initiative is coordinated by O. Coulaud and an application for its upgrade has been accepted.

8.1.2. Innovative simulation methods for large scale numeric prototypes on emerging architectures computers

Participants: Emmanuel Agullo, Olivier Coulaud, Aurélien Esnard, Mathieu Faverge, Luc Giraud, Abdou Guermouche, Pierre Ramet, Jean Roman.

Grant: Regional council
Dates: 2013 – 2015
Partners: EPIs REALOPT, RUNTIME from Inria Bordeaux Sud-Ouest, CEA-CESTA and l'Institut pluridisciplinaire de recherche sur l'environnement et les matériaux (IPREM) .
Overview: Numerical simulation is now integrated into all the design levels and the scientific studies for both academic and industrial contexts. Given the increasing size and sophistication of the simulations carried out, the use of parallel computing is inescapable. The complexity of such achievements requires collaboration of multidisciplinary teams capable of mastering all the necessary scientific skills for each component constituting the chain of expertise. In this project we consider each of these elements as well as efficient methods for parallel codes coupling. All these works is intended to contribute to the design large scale parallel multi-physics simulations. In addition to this research human activities the regional council also support some innovative computing equipment that will be embedded in the PlaFRIM experimental plateform, project led by Olivier Coulaud.

8.2. National Initiatives

8.2.1. Inria Project Lab

8.2.1.1. C2S@Exa - Computer and Computational Sciences at Exascale

Since January 2013, the team is participating to the C2S@EXA Inria Project Lab (IPL). This national initiative aims at the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society. At the current state of the art in technologies and methodologies, a multidisciplinary approach is required to overcome the challenges raised by the development of highly scalable numerical simulation software that can exploit computing platforms offering several hundreds of thousands of cores. Hence, the main objective of C2S@EXA is the establishment of a continuum of expertise in the computer science and numerical mathematics domains, by gathering researchers from Inria project-teams whose research and development activities are tightly linked to high performance computing issues in these domains. More precisely, this collaborative effort involves computer scientists that are experts of programming models, environments and tools for harnessing massively parallel systems, algorithmists that propose algorithms and contribute to generic libraries and core solvers in order to take benefit from all the parallelism levels with the main goal of optimal scaling on very large numbers of computing entities and, numerical mathematicians that are studying numerical schemes and scalable solvers for systems of partial differential equations in view of the simulation of very large-scale problems.

8.2.2. ANR

8.2.2.1. SOLHAR: SOLvers for Heterogeneous Architectures over Runtime systems

Participants: Emmanuel Agullo, Mathieu Faverge, Andra Hugo, Abdou Guermouche, Xavier Lacoste, Pierre Ramet, Jean Roman, Guillaume Sylvand.

Grant: ANR-MONU
Dates: 2013 – 2017
Partners: Inria (REALOPT, RUNTIME Bordeaux Sud-Ouest et ROMA Rhone-Alpes), IRIT/INPT, CEA-CESTA et EADS-IW.
Overview:

During the last five years, the interest of the scientific computing community towards accelerating devices has been rapidly growing. The reason for this interest lies in the massive computational power delivered by these devices. Several software libraries for dense linear algebra have been produced; the related algorithms are extremely rich in computation and exhibit a very regular pattern of access to data which makes them extremely good candidates for GPU execution. On the contrary, methods for the direct solution of sparse linear systems have irregular, indirect memory access patterns that adversely interact with typical GPU throughput optimizations.

This project aims at studying and designing algorithms and parallel programming models for implementing direct methods for the solution of sparse linear systems on emerging computer equipped with accelerators. The ultimate aim of this project is to achieve the implementation of a software package providing a solver based on direct methods for sparse linear systems of equations. To date, the approaches proposed to achieve this objective are mostly based on a simple offloading of some computational tasks to the accelerators and rely on fine hand-tuning of the code and accurate performance modeling to achieve efficiency. This project proposes an innovative approach which relies on the efficiency and portability of runtime systems. The development of a production-quality, sparse direct solver requires a considerable research effort along three distinct axis:

- linear algebra: algorithms have to be adapted or redesigned in order to exhibit properties that make their implementation and execution on heterogeneous computing platforms efficient and reliable. This may require the development of novel methods for defining data access patterns that are more suitable for the dynamic scheduling of computational tasks on processing units with considerably different capabilities as well as techniques for guaranteeing a reliable and robust behavior and accurate solutions. In addition, it will be necessary to develop novel and efficient accelerator

implementations of the specific dense linear algebra kernels that are used within sparse, direct solvers;

- runtime systems: tools such as the StarPU runtime system proved to be extremely efficient and robust for the implementation of dense linear algebra algorithms. Sparse linear algebra algorithms, however, are commonly characterized by complicated data access patterns, computational tasks with extremely variable granularity and complex dependencies. Therefore, a substantial research effort is necessary to design and implement features as well as interfaces to comply with the needs formalized by the research activity on direct methods;
- scheduling: executing a heterogeneous workload with complex dependencies on a heterogeneous architecture is a very challenging problem that demands the development of effective scheduling algorithms. These will be confronted with possibly limited views of dependencies among tasks and multiple, and potentially conflicting objectives, such as minimizing the makespan, maximizing the locality of data or, where it applies, minimizing the memory consumption.

Given the wide availability of computing platforms equipped with accelerators and the numerical robustness of direct solution methods for sparse linear systems, it is reasonable to expect that the outcome of this project will have a considerable impact on both academic and industrial scientific computing. This project will moreover provide a substantial contribution to the computational science and high-performance computing communities, as it will deliver an unprecedented example of a complex numerical code whose parallelization completely relies on runtime scheduling systems and which is, therefore, extremely portable, maintainable and evolvable towards future computing architectures.

8.2.2.2. SONGS: Simulation Of Next Generation Systems

Participant: Abdou Guermouche.

Grant: ANR 11 INFRA 13
Dates: 2011 – 2015
Partners: Inria (Bordeaux Sud-Ouest, Nancy - Grand Est, Rhone-Alpes, Sophia Antipolis - Méditerranée), I3S, LSIIT
Overview:

The last decade has brought tremendous changes to the characteristics of large scale distributed computing platforms. Large grids processing terabytes of information a day and the peer-to-peer technology have become common even though understanding how to efficiently such platforms still raises many challenges. As demonstrated by the USS SimGrid project funded by the ANR in 2008, simulation has proved to be a very effective approach for studying such platforms. Although even more challenging, we think the issues raised by petaflop/exaflop computers and emerging cloud infrastructures can be addressed using similar simulation methodology.

The goal of the SONGS project is to extend the applicability of the SimGrid simulation framework from Grids and Peer-to-Peer systems to Clouds and High Performance Computation systems. Each type of large-scale computing system will be addressed through a set of use cases and lead by researchers recognized as experts in this area.

Any sound study of such systems through simulations relies on the following pillars of simulation methodology: Efficient simulation kernel; Sound and validated models; Simulation analysis tools; Campaign simulation management.

8.2.2.3. ANEMOS: Advanced Numeric for ELMs : Modeling and Optimized Schemes

Participants: Xavier Lacoste, Guillaume Latu, Pierre Ramet.

Grant: ANR-MN
Dates: 2012 – 2016
Partners: Univ. Nice, CEA/IRFM, CNRS/MDS.

Overview: The main goal of the project is to make a significant progress in understanding of largely unknown at present physics of active control methods of plasma edge MHD instabilities Edge Localized Modes (ELMs) wich represent particular danger with respect to heat and particle loads for Plasma Facing Components (PFC) in ITER. Project is focused in particular on the numerical modelling study of such ELM control methods as Resonant Magnetic Perturbations (RMPs) and pellet ELM pacing both foreseen in ITER. The goals of the project are to improve understanding of the related physics and propose possible new strategies to improve effectiveness of ELM control techniques. The tool for the non-linear MHD modeling is the JOREK code which was essentially developed within previous ANR ASTER. JOREK will be largerly developed within the present project to include corresponding new physical models in conjunction with new developments in mathematics and computer science strategy. The present project will put the non-linear MHD modeling of ELMs and ELM control on the solid ground theoretically, computationally, and applications-wise in order to progress in urgently needed solutions for ITER.

Regarding our contributions, the JOREK code is mainly composed of numerical computations on 3D data. The toroidal dimension of the tokamak is treated in Fourier space, while the poloidal plane is decomposed in Bezier patches. The numerical scheme used involves a direct solver on a large sparse matrix as a main computation of one time step. Two main costs are clearly identified: the assembly of the sparse matrix, and the direct factorization and solve of the system that includes communications between all processors. The efficient parallelization of JOREK is one of our main goals, to do so we will reconsider: data distribution, computation distribution or GMRES implementation. The quality of the sparse solver is also crucial, both in term of performance and accuracy. In the current release of JOREK, the memory scaling is not satisfactory to solve problems listed above , since at present as one increases the number of processes for a given problem size, the memory footprint on each process does not reduce as much as one can expect. In order to access finer meshes on available supercomputers, memory savings have to be done in the whole code. Another key point for improving parallelization is to carefully profile the application to understand the regions of the code that do not scale well. Depending on the timings obtained, strategies to diminish communication overheads will be evaluated and schemes that improve load balancing will be initiated. JOREK uses PaStiX sparse matrix library for matrix inversion. However, large number of toroidal harmonics and particular thin structures to resolve for realistic plasma parameters and ITER machine size still require more aggressive optimisation in numeric dealing with numerical stability, adaptive meshes etc. However many possible applications of JOREK code we proposed here which represent urgent ITER relevant issues related to ELM control by RMPs and pellets remain to be solved.

8.2.2.4. OPTIDIS: OPTImisation d'un code de dynamique des DISlocations

Participants: Olivier Coulaud, Aurélien Esnard, Arnaud Etcheverry, Luc Giraud.

Grant: ANR-COSINUS
Dates: 2010 – 2014
Partners: CEA/DEN/DMN/SRMA (leader), SIMaP Grenoble INP and ICMPE / Paris-Est.
Overview: Plastic deformation is mainly accommodated by dislocations glide in the case of crystalline materials. The behavior of a single dislocation segment is perfectly understood since 1960 and analytical formulations are available in the literature. However, to understand the behavior of a large population of dislocations (inducing complex dislocations interactions) and its effect on plastic deformation, massive numerical computation is necessary. Since 1990, simulation codes have been developed by French researchers. Among these codes, the code TRIDIS developed by the SIMAP laboratory in Grenoble is the pioneer dynamic dislocation code. In 2007, the project called NUMODIS had been set up as team collaboration between the SIMAP and the SRMA CEA Saclay in order to develop a new dynamics dislocation code using modern computer architecture and advanced numerical methods. The objective was to overcome the numerical and physical limits of the previous code TRIDIS. The version NUMODIS 1.0 came out in December 2009, which confirms the feasibility of the project. The project OPTIDIS is initiated when the code NUMODIS is mature enough to consider parallel computation. The objective of the project in to develop and validate the algorithms in order to optimize the numerical and performance efficiency of the NUMODIS code. We are aiming at developing a code able to tackle realistic material problems such as the interaction between dislocations and irradiation defects in a grain plastic deformation after irradiation. These kinds of studies

where “local mechanisms" are correlated with macroscopic behavior is a key issue for nuclear industry in order to understand material aging under irradiation, and hence predict power plant secured service life. To carry out such studies, massive numerical optimizations of NUMODIS are required. They involve complex algorithms lying on advanced computational science methods. The project OPTIDIS will develop through joint collaborative studies involving researchers specialized in dynamics dislocations and in numerical methods. This project is divided in 8 tasks over 4 years. Two PhD thesis will be directly funded by the project. One will be dedicated to numerical development, validation of complex algorithms and comparison with the performance of existing dynamics dislocation codes. The objective of the second is to carry out large scale simulations to validate the performance of the numerical developments made in OPTIDIS. In both cases, these simulations will be compared with experimental data obtained by experimentalists.

8.2.2.5. RESCUE: RÉsilience des applications SCientifiqUEs

Participants: Emmanuel Agullo, Luc Giraud, Abdou Guermouche, Jean Roman, Mawussi Zounon.

Grant: ANR-Blanc (computer science theme)
Dates: 2010 – 2014
Partners: Inria EPI ROMA (leader) and GRAND LARGE.
Overview: The advent of exascale machines will help solve new scientific challenges only if the resilience of large scientific applications deployed on these machines can be guaranteed. With 10,000,000 core processors, or more, the time interval between two consecutive failures is anticipated to be smaller than the typical duration of a checkpoint, i.e., the time needed to save all necessary application and system data. No actual progress can then be expected for a large-scale parallel application. Current fault-tolerant techniques and tools can no longer be used. The main objective of the RESCUE project is to develop new algorithmic techniques and software tools to solve the exascale resilience problem. Solving this problem implies a departure from current approaches, and calls for yet-to-be-discovered algorithms, protocols and software tools.

This proposed research follows three main research thrusts. The first thrust deals with novel checkpoint protocols. This thrust will include the classification of relevant fault categories and the development of a software package for fault injection into application execution at runtime. The main research activity will be the design and development of scalable and light-weight checkpoint and migration protocols, with on-the-fly storing of key data, distributed but coordinated decisions, etc. These protocols will be validated via a prototype implementation integrated with the public-domain MPICH project. The second thrust entails the development of novel execution models, i.e., accurate stochastic models to predict (and, in turn, optimize) the expected performance (execution time or throughput) of large-scale parallel scientific applications. In the third thrust, we will develop novel parallel algorithms for scientific numerical kernels. We will profile a representative set of key large-scale applications to assess their resilience characteristics (e.g., identify specific patterns to reduce checkpoint overhead). We will also analyze execution trade-offs based on the replication of crucial kernels and on decentralized ABFT (Algorithm-Based Fault Tolerant) techniques. Finally, we will develop new numerical methods and robust algorithms that still converge in the presence of multiple failures. These algorithms will be implemented as part of a software prototype, which will be evaluated when confronted with realistic faults generated via our fault injection techniques.

We firmly believe that only the combination of these three thrusts (new checkpoint protocols, new execution models, and new parallel algorithms) can solve the exascale resilience problem. We hope to contribute to the solution of this critical problem by providing the community with new protocols, models and algorithms, as well as with a set of freely available public-domain software prototypes.

8.2.2.6. BOOST: Building the future Of numerical methOdS for iTer

Participants: Emmanuel Agullo, Luc Giraud, Abdou Guermouche, Jean Roman, Xavier Vasseur.

Grant: ANR-Blanc (applied math theme)
Dates: 2010 – 2014
Partners: Institut de Mathématiques de Toulouse (leader); Laboratoire d’Analyse, Topologie, Probabilités in Marseilles; Institut de Recherche sur la Fusion Magnétique, CEAr/IRFM and HIEPACS.

Overview: This project regards the study and the development of a new class of numerical methods to simulate natural or laboratory plasmas and in particular magnetic fusion processes. In this context, we aim in giving a contribution, from the mathematical, physical and algorithmic point of view, to the ITER project.

The core of this project consists in the development, the analysis, the implementation and the testing on real physical problems of the so-called Asymptotic-Preserving methods which allow simulations over a large range of scales with the same model and numerical method. These methods represent a breakthrough with respect to the state-of-the art. They will be developed specifically to handle the various challenges related to the simulation of the ITER plasma. In parallel with this class of methodologies, we intend to design appropriate coupling techniques between macroscopic and microscopic models for all the cases in which a net distinction between different regimes can be done. This will permit to describe different regimes in different regions of the machine with a strong gain in term of computational efficiency, without losing accuracy in the description of the problem. We will develop full 3-D solver for the asymptotic preserving fluid as well as kinetic model. The Asymptotic-Preserving (AP) numerical strategy allows us to perform numerical simulations with very large time and mesh steps and leads to impressive computational saving. These advantages will be combined with the utilization of the last generation preconditioned fast linear solvers to produce a software with very high performance for plasma simulation. For HIEPACS this project provides in particular a testbed for our expertise in parallel solution of large linear systems.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. EXA2CT

Type: COOPERATION

Defi: Exascale computation

Instrument: Specific Targeted Research Project

Duration: September 2013 - August 2016

See also: https://projects.imec.be/exa2ct/.

Coordinator: Wilfried Verachtert, IMEC (Interuniversitair Micro-Electronica Centrum), Belgium

Partner: Universiteit Antwerpen, Belgium; Università della Svizzera italiana, Switzerland; Inria (ALPINES, HIEPACS, SAGE teams); Université de Versailles Saint-Quentin-en-Yvelines, France; T-Systems, Germany; Fraunhofer-Gesellschaft, Germany; Intel, France; NAG, UK.

Inria contact: Luc Giraud

Abstract: Numerical simulation is a crucial part of science and industry in Europe. The advancement of simulation as a discipline relies on increasingly compute intensive models that require more computational resources to run. This is the driver for the evolution to exascale. Due to limits in the increase in single processor performance, exascale machines will rely on massive parallelism on and off chip, with a complex hierarchy of resources. The large number of components and the machine complexity introduce severe problems for reliability and programmability. The former of these will require novel fault-aware algorithms and support software. In addition, the scale of the numerical models exacerbates the difficulties by making the use of more complex simulation algorithms necessary, for numerical stability reasons. A key example of this is increased relience on linear solvers. Such solvers require global communication, which impacts scalability, and are often used with preconditioners, increasing complexity again. Unless there is a major rethink of the design of solver algorithms, components and software structure, a large class of important numerical simulations will not scale beyond petascale. This in turn will hold back the development of European science and industry that will not reap the benefits from exascale.

The EXA2CT project brings together experts at the cutting edge of the development of solvers, related algorithmic techniques, and HPC software architects for programming models and communication. It will take a revolutionary approach to exascale solvers and programming models, rather than

the incremental approach of other projects. We will produce modular open source proto-applications that demonstrate the algorithms and programming techniques developed in the project, to help bootstrap the creation of genuine exascale codes.

Inria is involved in that project through the IPL C2S@EXA initiative.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. MORSE

Title: Matrices Over Runtime Systems at Exascale

Inria principal investigator: Emmanuel Agullo

International Partner:

Institution: University of Tennessee Knoxville (United States)

Laboratory: Innovative Computing Lab

Researcher: George Bosilca

International Partner:

Institution: University of Colorado Denver (United States)

Laboratory: Department of Mathematics and Statistical Sciences

Researcher: Julien Langou

Duration: 2011 - 2013

See also: http://icl.cs.utk.edu/projectsdev/morse.

The goal of MORSE (Matrices Over Runtime Systems at Exascale) project is to design dense and sparse linear algebra methods that achieve the fastest possible time to an accurate solution on large-scale multicore systems with GPU accelerators, using all the processing power that future high end systems can make available. To develop software that will perform well on petascale and exascale systems with thousands of nodes and millions of cores, several daunting challenges have to be overcome, both by the numerical linear algebra and the runtime system communities. By designing a research framework for describing linear algebra algorithms at a high level of abstraction, the MORSE team will enable the strong collaboration between research groups in linear algebra and runtime systems needed to develop methods and libraries that fully benefit from the potential of future large-scale machines. Our project will take a pioneering step in the effort to bridge the immense software gap that has opened up in front of the High-Performance Computing (HPC) community.

8.4.1.2. FASTLA

Title: Fast and Scalable Hierarchical Algorithms for Computational Linear Algebra

Inria principal investigator: Olivier Coulaud

International Partners (Institution - Laboratory - Researcher):

Lawrence Berkeley National Laboratory (United States) - Scientific Computing Group - Esmond Ng

Stanford University (United States) - Institute for Computational and Mathematical Engineering - Eric Darve

Duration: 2012 - 2014

See also: http://people.bordeaux.inria.fr/coulaud/projets/FastLA_Website

In this project, we propose to study fast and scalable hierarchical numerical kernels and their implementations on heterogeneous manycore platforms for two major computational kernels in intensive challenging applications. Namely, fast multipole methods (FMM) and sparse hybrid linear solvers, that appear in many intensive numerical simulations in computational sciences. Regarding the FMM we plan to study novel generic formulations based on H-matrices techniques, that will be eventually validated in the field of material physics: the dislocation dynamics. For the hybrid solvers, new parallel preconditioning approaches will be designed and the use of H-matrices techniques will be first investigated in the framework of fast and monitored approximations on central components. Finally, the innovative algorithmic design will be essentially focused on heterogeneous manycore platforms. The partners, Inria HIEPACS, Lawrence Berkeley Nat. Lab and Stanford University, have strong, complementary and recognized experiences and backgrounds in these fields.

8.4.2. Participation In other International Programs

8.4.2.1. HOSCAR

We are involved in the Inria-CNPq HOSCAR project led by Stéphane Lanteri.

The general objective of the project is to setup a multidisciplinary Brazil-France collaborative effort for taking full benefits of future high-performance massively parallel architectures. The targets are the very large-scale datasets and numerical simulations relevant to a selected set of applications in natural sciences: (i) resource prospection, (ii) reservoir simulation, (iii) ecological modeling, (iv) astronomy data management, and (v) simulation data management. The project involves computer scientists and numerical mathematicians divided in 3 fundamental research groups: (i) numerical schemes for PDE models (Group 1), (ii) scientific data management (Group 2), and (iii) high-performance software systems (Group 3).

We organized the 2013 annual meeting in Bordeaux on September 2-6, 2013 and are contributing to the Group 3 activities.

8.4.2.2. G8-ECS

Title: Enabling Climate Simulations at Extreme Scale

Inria principal investigator: Luc Giraud

International Partners (Institution - Researcher):

Univ. Illinois at Urbanna Champaign & Argonne National Lab. - Franck Cappello,

Univ. Tennessee at Knoxville - George Bosilca,

German Research School for Simulation Sciences - Felix Wolf,

Univ. Victoria - Andrew Weaver,

Titech - Satoshi Matsuoka,

Univ. Tsukuba - Mitsuhisa Sato,

NCAR - Rich Loft,

Barcelona Supercomputing Center - Jesus Labarta.

Duration: 2011 - 2014

See also: https://wiki.engr.illinois.edu/display/G8/G8+ESC++–+Enabling+Climate+Simulations+at+Extreme+Scale

Exascale systems will allow unprecedented reduction of the uncertainties in climate change predictions via ultra-high resolution models, fewer simplifying assumptions, large climate ensembles and simulation at a scale needed to predict local effects. This is essential given the cost and consequences of inaction or wrong actions about climate change. To achieve this, we need careful co-design of future exascale systems and climate codes, to handle lower reliability, increased heterogeneity, and increased importance of locality. Our effort will initiate an international collaboration of climate and computer scientists that will identify the main roadblocks and analyze and test initial solutions for

the execution of climate codes at extreme scale. This work will provide guidance to the future evolution of climate codes. We will pursue research projects to handle known roadblocks on resilience, scalability, and use of accelerators and organize international, interdisciplinary workshops to gather and disseminate information. The global nature of the climate challenge and the magnitude of the task strongly favor an international collaboration. The consortium gathers senior and early career researchers from USA, France, Germany, Spain, Japan and Canada and involves teams working on four major climate codes (CESM1, EC-EARTH, ECSM, NICAM).

PHOENIX Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. HomeAssist: Platform for Assisted Living

The objective of this project is to provide an open platform of digital assistance dedicated to aging in place. This project is in collaboration with researchers in Cognitive Science (Bordeaux University) and the UDCCAS Gironde (Union Départementale des Centres Communaux d'Action Sociale) managing elderly care. This project includes a need analysis, the development of assistive applications and their experimental validation.

This work is funded by CARSAT Aquitaine ("Caisse d'Assurance Retraite et de la Santé au Travail"), Aquitaine Region and Conseil Général de la Gironde.

7.1.2. Cognitive Assistance for Supporting the Autonomy of Persons with Intellectual Disabilities

The objective of this project is to develop assistive technologies enabling people with intellectual disabilities to gain independence and to develop self-determined behaviors, such as making choices and taking decisions. This project is in collaboration with the "Handicap et Système Nerveux" reserach group (EA 4136, Bordeaux University), the TSA Chair of UQTR (Université du Québec à Trois-Rivières) in Psychology and the Association Trisomie 21 Gironde (Down's Syndrom). The TSA chair has recently designed and built a smart apartment that is used to conduct experimental evaluation of our assistive technologies in realistic conditions.

7.1.3. Certification of an open platform

The purpose of this project is to define concepts and tools for developing certifying open platforms. This certification process must ensure a set of critical properties (*e.g.,* safety, confidentiality, security) by certifying each tier application. These guarantees are essential to ensure that openness does not come at the expense of the user's well-being. To preserve the innovation model of open platforms, this certification process should also be as automatic as possible. Indeed, the success of open platforms is mainly due to the low development cost of a new application. The case study of this thesis will be the domain of home automation. The results of this thesis will be put into practice in the DiaSuiteBox open platform.

This project is funded by Aquitaine Region.

7.2. National Initiatives

7.2.1. Objects' World: design-driven development of large-scale smart spaces

The goal of this project is to develop an innovative communication technology, allowing the emergence of a new economic sector for large-scale smart spaces. Our objective is to propose concepts and tools for developing reliable applications orchestrating large-scale smart spaces of networked entities. The industrial partners of the Objects' World project will provide us with real-size case studies in various application domains (e.g., smart cities, tracking of vehicles, healthcare, energy management).

This work is funded by the OSEO national agency.

7.2.2. School Inclusion for Children with Autism

The objective of this project is to provide children with assistive technologies dedicated to the school routines. This project is in collaboration with the "Handicap et Système Nerveux" research group (EA 4136, Bordeaux University), the PsyCLÉ research center (EA 3273, Provence Aix-Marseille University) and the "Parole et Langage" research laboratory (CNRS, Provence Aix-Marseille University).

This work is funded by the French Ministry of National Education.

7.3. European Initiatives

7.3.1. FP7 Projects

Program: FP7 - ICT - 2013.5.3

Project acronym: RAPP

Project title: Robotic Applications for Delivering Smart User Empowering Applications

Duration: From Dec-2013 until Dec-2016

Coordinator: Center For Research and Technology Hellas, CERTH/ITI, Greece

Other partners:

- Politechnika Warszarwska, WUT, Poland
- Sigma Orionis SA, France
- Ortelio LTD, United Kingdom
- Idryma Ormylia, Greece
- Fundacion Instituto Gerontologico Matia - Ingema, spain

Abstract: RAPP will provide a software platform in order to support the creation and delivery of robotics applications (RAPPs) targeted to people at risk of exclusion, especially older people. The open-source software platform will provide an API that contains the functionalities for implementing RAPPs and accessing the robot's sensors and actuators using higher level commands, by adding a middleware stack with added functionalities suitable for different kinds of robots. RAPP will expand the computational and storage capabilities of robots and enable machine learning operations, distributed data collection and processing, and knowledge sharing among robots in order to provide personalized applications based on adaptation to individuals. The use of a common API will assist developers is creating improved applications for different types of robots that target to people with different needs, capabilities and expectations, while at the same time respect their privacy and autonomy, thus the proposed RAPP Store will have a profound effect in the robotic application market. The results of RAPP will be evaluated through the development and benchmarking of social assistive RAPPs, which exploit the innovative features (RAPP API, RAPP Store, knowledge reuse, etc.) introduced by the proposed paradigm.

7.3.2. Collaborations in European Programs, except FP7

Program: SUDOE territorial cooperation program (Interreg IV B)

Project acronym: Biomasud

Project title: Mechanisms for sustainability and enhancement of solid biomass market in the space of SUDOE

Duration: July 2011 - June 2013

Coordinator: AVEBIOM

Other partners: UCE (Consumers Union of Spain), CIEMAT (Public Research Agency for excellence in energy and environment, Spain), CBE (Centro da Biomassa para a Energia, Portugal), CVR (Centro para la Valorización de Residuos, Portugal) and UCFF (Union Française de la Coopération Forestière, France)

Abstract: The goal of the Biomasud european project is to show the viability of the biomass-based energy model. The project aims to propose a certification and traceability process throughout the value chain of biofuel. Our objective is to design and implement a prototype of traceability system that will extract automatically traceability information based on sensors such as RFID tags, simplifying the certification process. This work will leverage our DIASUITE development methodology and will be evaluated by the Biomasud partners.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. OPALI

Title: OPen Assistive-technology platform for independent LIving

Inria principal investigator: Emilie Balland

International Partner (Institution - Laboratory - Researcher): University of Québec Trois-Rivières (Canada) - TSA Research Chair - Dany Lussier-Desrochers

Duration: 2013 - 2015

See also: http://phoenix.inria.fr/opali

The goal of the OPALI project is to develop an Open Platform for Assisted Living targeting users with cognitive disabilities. It is a cross-disciplinary project combining expertise in (1) Computer Science focusing in development of applications orchestrating networked devices and (2) Psychology focusing in assistive technologies for users with cognitive disabilities. Furthermore, this project will leverage a unique research vehicle created by the University of Trois-Rivières consisting of a full-fledged apartment equipped with a range of networked devices and dedicated to experimental studies. The outcome of the project will include a large catalog of assistive applications allowing to match each user's project life.

7.5. International Research Visitors

7.5.1. Visits to International Teams

- Charles Consel, sabbatical year at McGill University, Montreal, Canada (From August 2012 to July 2013)

RUNTIME Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

REGION AQUITAINE The Aquitaine Region Council is granting the PhD thesis of Andra Hugo about *Composability of parallel software over hybrid architectures*, from september 2011 to august 2014.

REGION AQUITAINE The Aquitaine Region Council is granting the PhD thesis of Bertrand Putigny about *Performance Models for Heterogeneous Parallel Architectures*.

REGION AQUITAINE - CEA The Aquitaine Region Council together with CEA is funding PhD thesis of Marc Sergent (2013-2016) on *Scalability for Task-based Runtimes* (See also Section Bilateral Grants with Industry)

8.2. National Initiatives

8.2.1. ANR

ANR COOP Multi-level Cooperative Resource Management (http://coop.gforge.inria.fr/).

ANR COSINUS 2009 Program, 12/2009 - 06/2013 (42 months)

Identification: ANR-09-COSI-001

Coordinator: Christian Pérez (Inria Rhône-Alpes)

Other partners: Inria Bordeaux, Inria Rennes, IRIT, EDF R&D.

Abstract: COOP aims at establishing generic cooperation mechanisms between resource management, runtime systems, and application programming frameworks to simplify programming models, and improve performance through adaptation to the resources.

ANR SOLHAR (http://solhar.gforge.inria.fr/doku.php?id=start).

ANR MONU 2013 Program, 2013 - 2016 (36 months)

Identification: ANR-13-MONU-0007

Coordinator: Inria Bordeaux/LaBRI

Other partners: CNRS-IRIT, Inria-LIP Lyon, CEA/CESTA, EADS-IW

Abstract: This project aims at studying and designing algorithms and parallel programming models for implementing direct methods for the solution of sparse linear systems on emerging computers equipped with accelerators. The ultimate aim of this project is to achieve the implementation of a software package providing a solver based on direct methods for sparse linear systems of equations. Several attempts have been made to accomplish the porting of these methods on such architectures; the proposed approaches are mostly based on a simple offloading of some computational tasks (the coarsest grained ones) to the accelerators and rely on fine hand-tuning of the code and accurate performance modeling to achieve efficiency. This project proposes an innovative approach which relies on the efficiency and portability of runtime systems, such as the StarPU tool developed in the runtime team (Bordeaux). Although the SOLHAR project will focus on heterogeneous computers equipped with GPUs due to their wide availability and affordable cost, the research accomplished on algorithms, methods and programming models will be readily applicable to other accelerator devices such as ClearSpeed boards or Cell processors.

ANR Songs Simulation of next generation systems (http://infra-songs.gforge.inria.fr/).

ANR INFRA 2011, 01/2012 - 12/2015 (48 months)

Identification: ANR-11INFR01306

Coordinator: Martin Quinson (Inria Nancy)

Other partners: Inria Nancy, Inria Rhône-Alpes, IN2P3, LSIIT, Inria Rennes, I3S.

Abstract: The goal of the SONGS project is to extend the applicability of the SIMGRID simulation framework from Grids and Peer-to-Peer systems to Clouds and High Performance Computation systems. Each type of large-scale computing system will be addressed through a set of use cases and lead by researchers recognized as experts in this area.

ANR MOEBUS Sceduling in HPC (http://moebus.gforge.inria.fr/doku.php).

ANR INFRA 2013, 10/2013 - 9/2017 (48 months)

Coordinator: Denis Trystram (Inria Rhône-Alpes)

Other partners: Inria Bordeaux.

Abstract: This project focuses on the efficient execution of parallel applications submitted by various users and sharing resources in large-scale high-performance computing environments

8.2.2. Inria Project Lab

8.2.2.1. C2S@Exa - Computer and Computational Scienecs at Exascale

Participant: Olivier Aumage [RUNTIME project-team, Inria Bordeaux - Sud-Ouest].

Since January 2013, the team is participating to the C2S@Exa http://www-sop.inria.fr/c2s_at_exa Inria Project Lab (IPL). This national initiative aims at the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society. At the current state of the art in technologies and methodologies, a multidisciplinary approach is required to overcome the challenges raised by the development of highly scalable numerical simulation software that can exploit computing platforms offering several hundreds of thousands of cores. Hence, the main objective of C2S@Exa is the establishment of a continuum of expertise in the computer science and numerical mathematics domains, by gathering researchers from Inria project-teams whose research and development activities are tightly linked to high performance computing issues in these domains. More precisely, this collaborative effort involves computer scientists that are experts of programming models, environments and tools for harnessing massively parallel systems, algorithmists that propose algorithms and contribute to generic libraries and core solvers in order to take benefit from all the parallelism levels with the main goal of optimal scaling on very large numbers of computing entities and, numerical mathematicians that are studying numerical schemes and scalable solvers for systems of partial differential equations in view of the simulation of very large-scale problems.

8.2.2.2. MULTICORE - Large scale multicore virtualization for performance scaling and portability

Participant: Emmanuel Jeannot [RUNTIME project-team, Inria Bordeaux - Sud-Ouest].

Multicore processors are becoming the norm in most computing systems. However supporting them in an efficient way is still a scientific challenge. This large-scale initiative 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. It aims to build collaborative virtualization mechanisms that achieve essential tasks related to parallel execution and data management. We want to unify the analysis and transformation processes of programs and accompanying data into one unique virtual machine. We hope delivering a solution for compute-intensive applications running on general-purpose standard computers.

8.3. European Initiatives

8.3.1. FP7 Projects

HPC-GA

Program: FP7 IRSES Marie-Curie

Project acronym: HPC-GA

Project title: High Performance Computing for Geophysics Applications

Duration: Jan 2012 - Dec 2014

Coordinator: Jean-François Méhaut (UJF, France)

Other partners: UFRGS, Inria, BCAM et UNAM.

Abstract: The design and implementation of geophysics applications on top of nowadays supercomputers requires a strong expertise in parallel programming and the use of appropriate runtime systems able to efficiently deal with heterogeneous architectures featuring many-core nodes typically equipped with GPU accelerators. The HPC-GA project aims at evaluating the functionalities provided by current runtime systems in order to point out their limitations. It also aims at designing new methods and mechanisms for an efficient scheduling of processes/threads and a clever data distribution on such platforms. The HPC-GA project is unique in gathering an international, pluridisciplinary consortium of leading European and South American researchers featuring complementary expertise to face the challenge of designing high performance geophysics simulations for parallel architectures.

MontBlanc2

Program: FP7 ICT-2013, Exascale Computing Platforms

Project acronym: MontBlanc2

Project title: European scalable and power efficient HPC platform based on low-power embedded technology

Duration: Oct 2013 - Nov 2016

Coordinator: Alex Ramirez (BSC, Spain)

Other partners: Inria, Bull, ST, ARM, Gnodal, Juelich, BADW-LRZ, HLRS, CNRS, CEA, CINECA, Bristol, Allinea

Abstract: The Mont-Blanc project aims to develop a European Exascale approach leveraging on commodity power-efficient embedded technologies. The project has developed a HPC system software stack on ARM, and will deploy the first integrated ARM-based HPC prototype by 2014, and is also working on a set of 11 scientific applications to be ported and tuned to the prototype system. The rapid progress of Mont-Blanc towards defining a scalable power efficient Exascale platform has revealed a number of challenges and opportunities to broaden the scope of investigations and developments. Particularly, the growing interest of the HPC community in accessing the Mont-Blanc platform calls for increased efforts to setup a production-ready environment. The Mont-Blanc 2 proposal has 4 objectives:

1. To complement the effort on the Mont-Blanc system software stack, with emphasis on programmer tools (debugger, performance analysis), system resiliency (from applications to architecture support), and ARM 64-bit support
2. To produce a first definition of the Mont-Blanc Exascale architecture, exploring different alternatives for the compute node (from low-power mobile sockets to special-purpose high-end ARM chips), and its implications on the rest of the system

3. To track the evolution of ARM-based systems, deploying small cluster systems to test new processors that were not available for the original Mont-Blanc prototype (both mobile processors and ARM server chips)
4. To provide continued support for the Mont-Blanc consortium, namely operations of the original Mont-Blanc prototype, the new small scale prototypes and hands-on support for our application developers

Mont-Blanc 2 contributes to the development of extreme scale energy-efficient platforms, with potential for Exascale computing, addressing the challenges of massive parallelism, heterogeneous computing, and resiliency. Mont-Blanc 2 has great potential to create new market opportunities for successful EU technology, by placing embedded architectures in servers and HPC..

8.3.2. Collaborations in European Programs, except FP7

COST ComplexHPC http://complexhpc.org

Program: COST Action IC0805

Project acronym: ComplexHPC

Project title: Open European Network for High-Performance Computing in Complex Environments

Duration: May 2009 - June 2013

Coordinator: Emmanuel Jeannot

Other partners: This Action gathers more than 20 countries and 30 partners in Europe.

Abstract: The goal of the Action is to establish a European research network focused on high performance heterogeneous computing in order to address the whole range of challenges posed by these new platforms including models, algorithms, programming tools and applications. The network will aim at contributing to exchange information, identify synergies and pursue common research activities, therefore reinforcing the strength of European research groups and the leadership of Europe in this field.

8.4. International Initiatives

8.4.1. Inria Associate Teams

MORSE Matrices Over Runtime Systems at Exascale

Inria Associate-Teams program: 2011-2016

Coordinator: Emmanuel Agullo (Hiepacs)

Parners: Inria (Runtime & Hiepacs), University of Tennessee Knoxville, University of Colorado Denver and KAUST.

Abstract: The Matrices Over Runtime Systems at Exascale (MORSE) associate team has vocation to design dense and sparse linear algebra methods that achieve the fastest possible time to an accurate solution on large-scale multicore systems with GPU accelerators, using all the processing power that future high end systems can make available. To develop software that will perform well on petascale and exascale systems with thousands of nodes and millions of cores, several daunting challenges have to be overcome both by the numerical linear algebra and the runtime system communities. With Inria Hiepacs, University of Tennessee, Knoxville and University of Colorado, Denver.

8.4.2. Inria International Labs

JLPC on Petascale Computing Inria joint-Lab

Coordinators: Franck Cappello and Marc Snir.

Other partners: Argonne National Lab, Inria, University of Urbanna Champaign.

Abstract: he Joint Laboratory is based at Illinois and includes researchers from Inria, Illinois' Center for Extreme-Scale Computation, and the National Center for Supercomputing Applications. It focuses on software challenges found in complex high-performance computers.

8.4.3. Participation in other International Programs

ANR-JST FP3C Framework and Programming for Post Petascale Computing.

ANR-JST 2010 Program, 01/09/2010 - 31/03/2014

Identification: ANR-10-JST-002

Coordinator: Serge Petiton (Inria Saclay)

Other partners: CNRS IRIT, CEA DEN Saclay, Inria Bordeaux, CNRS-Prism, Inria Rennes, University of Tsukuba, Tokyo Institute of Technology, University of Tokyo, Kyoto University.

Abstract: Post-petascale systems and future exascale computers are expected to have an ultra large-scale and highly hierarchical architecture with nodes of many-core processors and accelerators. That implies that existing systems, language, programming paradigms and parallel algorithms would have, at best, to be adapted. The overall structure of the FP3C project represents a vertical stack from a high level language for end users to low level architecture considerations, in addition to more horizontal runtime system researches.

HPC-GA High Performance Computing for Geophysics Applications (http://project.inria.fr/HPC-GA/)

European FP7 Programme, "Marie Curie" Action, PIRSES Scheme, 01/2012 - 12/2014 (36 months)

Identification: PIRSES-GA-2011-295217

Coordinator: Jean-François Méhaut (UJF)

Other Partners: Inria Grenoble, Inria Bordeaux, Basque Center for Applied Mathematics (BCAM, Bilbao, Spain), Federal University of Rio Grande do Sul (UFRGS, Porto Alegre, Brazil), Universidad Nacional Autónoma de México (UNAM, Mexico, Mexico), Bureau de Recherche Géologique et Minière (BRGM, Orléans, France), Grand Équipement National de Calcul Intensif (GENCI, France).

Abstract: The HPC-GA project is unique in gathering an international, pluridisciplinary consortium of leading European and South American researchers featuring complementary expertise to face the challenge of designing high performance geophysics simulations for parallel architectures: UFRGS, Inria, BCAM and UNAM. Results of this project will be validated using data collected from real sensor networks. Results will be widely disseminated through high-quality publications, workshops and summer-schools.

SEHLOC Scheduling evaluation in heterogeneous systems with hwloc

STIC-AmSud 2012 Program, 01/2013 - 12/2014 (24 months)

Coordinator: Brice Goglin

Other Partners: Universidad Nacional de San Luis (Argentina), Universidad de la Repúpublica (Uruguay).

Abstract: This project focuses on the development of runtime systems that combine application characteristics with topology information to automatically offer scheduling hints that try to respect hardware and software affinities. Additionally we want to analyze the convergence of the obtained performance from our algorithms with the recently proposed Multi-BSP model which considers nested levels of computations that correspond to natural layers of nowadays hardware architectures.

NextGN Preparing for Next Generation Numerical Simulation Platforms

PUF (Partner University Fund) - France USA, 01/2013 - 12-2016 (3 years)

Coordinator: Franck Capello, Marc Snir and Yves Robert

Other Partners: Inria, Argonne National Lab and University of Urbanna Chapaign

This PUF proposal builds on the existing successful joint laboratory between Inria and UIUC that has produced in past three years and half many top-level publications, some of which resulted in student awards; and several software packages that are making their way to production in Europe and USA. The proposal extends the collaboration to Argonne National Laboratory (ANL) and CNRS researchers who will bring their unique expertise and their skills to help addressing the scalability issue of simulation platforms.

FLOWERS Project-Team

8. Partnerships and Cooperations

8.1. Scientific Collaborations (outside consortium projects)

8.1.1. Collaboration and technological transfer with Laboratoire de Physiologie de la Perception et de l'Action (LPPA)

A collaboration is in progress with Jacques Droulez and Steve Nguyen from Laboratoire de Physiologie de la Perception et de l'Action (LPPA), Paris. Poppy represents for them a humanoid platform very interesting because it is relatively flexible and versatile, with more similar proportions to that of humans, which facilitate comparison with the experimental results obtained in humans. The laboratory will evaluate this platform probabilistic methods of control of balance and locomotion.

In the short term the first experimental project with Poppy will test methods of management support, in the case of restoration of balance, in the case of walking to correct or prepare a change of direction. This project will be initiated in the framework of a long internship of master 2 that starts in January. In the future, we would also like to evaluate motor controllers compliant, and learning algorithms. This collaboration involves Matthieu Lapeyre and Pierre-Yves Oudeyer.

8.1.2. Collaborations with Gipsa-Lab, Laboratoire de Psychologie et de Neurocognition (LPNC) and Laboratoire de Physiologie de la Perception et de l'Action (LPPA)

Clément Moulin-Frier is continuing his collaborative work with people he worked with during his PhD thesis at GIPSA-Lab, LPNC and LPPA. See the section entitled "COSMO (Communicating about Objects using Sensory-Motor Operations): a Bayesian modeling framework for studying speech communication and the emergence of phonological systems" for more information. He is also continuing his collaborative work with people he worked with during his post-doc in 2011 at LPPA. See the section entitled "Probabilistic optimal control: a quasimetric approach" for more information.

8.1.3. Collaboration with the Computer Science Department of the University of Zaragoza

A collaboration is in progress with Iñaki Iturrate and Luis Montesano at Zaragoza University, Spain. We aim a devellopping a calibration free Brain Computer Interaction system through the use and extension of learning algorithm developped in the team [43], [45], [44]. We focus our effort on error related potentials that occur in the brain while observing or performing a task. They supposedly play a role in human learning as implicit feedback signals that evaluate the correctness or unexpectedness of received stimuli. Our goal is to automatically and reliably detect and classify these signals to provide feedback to artificial systems (e.g. a robot) that learn how to interact and adapt themselves to the user intentions and preferences.

8.2. Regional Initiatives

8.2.1. FUI ROBOT POPULI

This project leaded by Awabot (http://www.awabot.com) funded from 2012 to 2014 aims to investigate, prototype, and test new applications and interactions between the robot and the user to move from niche markets to the general public. This project builds on the theories of Geoffrey Moore (Crossing the Chasm), putting the user at the center of the product design and following the vision of a playful robot and connected to the cloud, where the robot is an interface for advanced interactive entertainment of the future. It brings together partners with complementary expertise to develop and / or adapt and integrate technological bricks missing to fulfill such a vision. Our goal in this project is to develop a robust and low cost navigation system based on RGB-D cameras.

Partners : ARTEFACTS STUDIO, LIRIS, ENSTA ParisTech, GAMAGORA (Université Lyon 2)

8.2.2. PSPC ROMEO 2

This project leaded by Aldebaran Robotics (http://www.aldebaran-robotics.com/) funded from 2012 to 2016 by OSEO aims at developping a humanoid robot for assisting people. The contribution of FLOWERS and ENSTA ParisTech are in the area of human-robot interaction, learning by demonstration, perception and semantic mapping.

Partners : ALL4TEC, Inria, CNRS, VOXLER, SPIROPS, ISIR, UVSQ, CEA LIST, ENSTA ParisTech, STRATE COLLEGE, TELECOM PARISTECH, ASSOCIATION APPROCHE

Web site: http://www.aldebaran-robotics.com/fr/Projets/romeo.html

8.3. National Initiatives

8.3.1. ANR MACSi

An ANR Project (MACSi, ANR Blanc 0216 02), coordinated by ISIR/Univesity Paris VI (Olivier Sigaud), on developmental robotics (motor learning, visual learning, and exploration algorithms on the ICub robot) continued. The MACSi project is a developmental robotics project based on the iCub humanoid robot and the Urbi open source software platform. It is funded an as ANR Blanc project from 2010 to 2013. The project addresses four fundamental challenges, led by four partners:

- How can a robot learn efficient perceptual representations of its body and of external objects given initially only low-level perceptual capabilities? Challenge leader : Inria-ENSTA-ParisTech FLOWERS (Paris).
- How can a robot learn motor representations and use them to build basic affordant reaching and manipulation skills? Challenge leader : ISIR-UPMC-Paris 6 (Paris). ISIR hosts the iCub humanoid robot on which the achievements will be evaluated.
- What guidance heuristics should be used to explore vast sensorimotor spaces in unknown changing bodies and environments? Challenge leader : Inria-ENSTA-ParisTech FLOWERS (Bordeaux).
- How can mechanisms for building efficient representations/abstractions, mechanisms for learning manipulation skills, and guidance mechanisms be integrated in the same experimental robotic architecture and reused for different robots? Challenge leader : GOSTAI company (Paris).

Web site: http://macsi.isir.upmc.fr/

8.4. European Initiatives

8.4.1. FP7 Projects

8.4.1.1. 3rd HAND

Type: COOPERATION

Defi:ICT-2013.2.1 Robotics, Cognitive Systems & Smart Spaces, Symbiotic Interaction

Instrument: Collaborative project

Objectif: Target a) Intelligent robotics systems

Duration: October 2013 - September 2017

Coordinator: Inria, France

Partner: Universitaet Darmstadt, Germany

Partner: Stuttgart University, Germany

Partner: University of Innsbruck, Austria

Inria contact: Manuel Lopes

Abstract: Robots have been essential for keeping industrial manufacturing in Europe. Most factories have large numbers of robots in a fixed setup and few programs that produce the exact same product hundreds of thousands times. The only common interaction between the robot and the human worker has become the so-called ”emergency stop button”. As a result, re-programming robots for new or personalized products has become a key bottleneck for keeping manufacturing jobs in Europe. The core requirement to date has been the production in large numbers or at a high price. Robot-based small series production requires a major breakthrough in robotics: the development of a new class of semi-autonomous robots that can decrease this cost substantially. Such robots need to be aware of the human worker, alleviating him from the monotonous repetitive tasks while keeping him in the loop where his intelligence makes a substantial difference.

In this project, we pursue this breakthrough by developing a semi-autonomous robot assistant that acts as a third hand of a human worker. It will be straightforward to instruct even by an untrained layman worker, allow for efficient knowledge transfer between tasks and enable a effective collaboration between a human worker with a robot third hand. The main contributions of this project will be the scientific principles of semi-autonomous human-robot collaboration, a new semi-autonomous robotic system that is able to: i) learn cooperative tasks from demonstration; ii) learn from instruction; and iii) transfer knowledge between tasks and environments.

8.4.1.2. ERC EXPLORERS

Instrument: ERC Starting Grant

Duration: December 2009 - November 2014

Coordinator: Pierre-Yves Oudeyer, Inria.

Abstract: In spite of considerable and impressive work in artificial intelligence, machine learning, and pattern recognition in the past 50 years, we have no machine capable of adapting to the physical and social environment with the flexibility, robustness and versatility of a 6-months old human child. Instead of trying to simulate directly the adult's intelligence, EXPLORERS proposes to focus on the developmental processes that give rise to intelligence in infants by re-implementing them in machines. Framed in the developmental/epigenetic robotics research agenda, and grounded in research in human developmental psychology, its main target is to build robotic machines capable of autonomously learning and re-using a variety of skills and know-how that were not specified at design time, and with initially limited knowledge of the body and of the environment in which it will operate. This implies several fundamental issues: How can a robot discover its body and its relationships with the physical and social environment? How can it learn new skills without the intervention of an engineer? What internal motivations shall guide its exploration of vast spaces of skills? Can it learn through natural social interactions with humans? How to represent the learnt skills and how can they be re-used? EXPLORERS attacks directly those questions by proposing a series of scientific and technological advances: 1) we will formalize and implement sophisticated systems of intrinsic motivation, responsible of organized spontaneous exploration in humans, for the regulation of the growth of complexity of learning situations; 2) intrinsic motivation systems will be used to drive the learning of forward/anticipative sensorimotor models in high-dimensional multimodal spaces, as well as the building of reusable behavioural macros; 3) intrinsically motivated exploration will be coupled with social guidance from non-engineer humans; 4) an information-theoretic framework will complement intrinsically motivated exploration to allow for the inference of body maps; 5) we will show how learnt basic sensorimotor skills can be re-used to learn the meaning of early concrete words, pushing forward human-robot mutual understanding. Furthermore, we will setup large scale experiments, in order to show how these advances can allow a high-dimensional multimodal robot to learn collections of skills continuously in a weeks-to-months time scale. This project not only addresses fundamental scientific questions, but also relates to important societal issues: personal home robots are bound to become part of everyday life in the 21st century, in particular as helpful social companions in an aging society. EXPLORERS' objectives converge to the challenges implied by this vision: robots will have to be able to adapt and learn new skills in the unknown homes of users who are not engineers.

8.5. International Initiatives

8.5.1. Inria Associate Teams

8.5.1.1. NEUROCURIOSITY

Title: NeuroCuriosity

Inria principal investigator: Manuel Lopes

International Partner (Institution - Laboratory - Researcher):

Columbia Neuroscience (United States) - Jacqueline Goetlieb

Duration: 2013 - 2015

One of the most striking aspects of human behavior is our enormous curiosity, drive for exploration. From a child feverishly examining a new toy with its hands and its eyes, to a tourist exploring a new city, to a scientist studying the brain, humans incessantly want to know. This exuberant curiosity shapes our private and social lives, and is arguably a key cognitive feature that allows our species to understand, control and alter our world. We aim to develop a novel unified biological and computational theory, which explains curiosity in the domain of visual exploration and attention as a deliberate decision motivated by learning progress. This theory will build and improve upon pioneer computational models of intrinsic motivation elaborated in developmental robotics, and be empirically evaluated in the context of visual exploration in monkeys through behavioral and brain imaging techniques. This will be the first attempt at a biological-computational framework of intrinsic motivation and perceptual exploration and their underlying cognitive mechanisms. This collaboration involves Pierre-Yves Oudeyer and Manuel Lopes on the Inria side, and Jacqueline Gottlieb and Adrien Baranes on Univ. Columbia side.

8.6. International Research Visitors

8.6.1. Visits of International Scientists

- Jan Peters, Technische Universitaet Darmstadt
- Marc Toussaint, Stuttgart University
- Justus Piater, University of Innsbruck
- Luis Montesano, University of Zaragoza
- Michael Mistry, Lecturer in Robotics, Intelligent Robotics Lab, University of Birmingham
- Andrej Gams, Post-doc, Biorobotics Laboratory, EPFL
- Adrien Baranes, Columbia University, NY, US
- Katharina Rohlfing, Bielefeld University, Germany
- Yannis Demiris, Imperial College, UK
- Andrew Barto, Univ. Massachussets at Amherst, US

8.6.1.1. Internships

- Jules Brochard, Emergent Proximo-Distal Maturation through Adaptive Exploration
- Axel Davy, Safe exploration in MDPs
- Julie Golliot, Experimental Platform for User Study of Curiosity-driven Exploration
- Brice Miard, Experimental Platform for User Study of Curiosity-driven Exploration
- Chloé Rozenbaum, Learning Simultaneously New Tasks and Feedback Models in Socially Guided Robot Learning
- Caio Tomazelli Da Silva Oliveira, Multimodal learning of speech-action-video primitives

8.6.2. Visits to International Teams

PY Oudeyer visited Gottlieb's Cognitive Neuroscience lab at Columbia University, NY, US; CITEC at Bielefeld University, Germany.

F. Stulp visited the Max Planck Institute for Intelligent Systems (Stefan Schaal) in Tuebingen, Germany.

In May 2013, Matthieu Lapeyre visited the Bristol Robotic Lab to present the Poppy robot. A close collaboration will begin in 2014, in particular they will hire an engineer to design grasping hand for Poppy.

In May 2013, Jonathan Grizou visited Iñaki Iturrate and Luis Montesano at Zaragoza University, Spain.

In July 2013, Manuel Lopes visit the lab of Andrea Thomaz at Georgia Tech.

In August 2013, Clément Moulin-Frier visited the Honda Research Center in Tokyo as well as Pr. Sawada at Kagawa University, Japan. He gave talks in both labs. He also visited the Intelligent Robotics Laboratory directed by Prof. Hiroshi Ishiguro and Asada Laboratory directed by Prof. Minoru Asada, in Osaka. In October 2013 he visited the Developmental Neuromechanics & Communication Lab at Princeton University, USA.

In August 2013, Fabien Benureau, Olivier Mangin, Mai Nguyen and Jonathan Grizou, visited the Intelligent Robotics Laboratory directed by Prof. Hiroshi Ishiguro, Osaka; the Humanoid Robotics Institute directed by Prof. Atsuo Takanishi, Tokyo; Intelligent Systems and Informatics Laboratory directed by Prof. Yasuo Kuniyoshi, Tokyo; and Asada Laboratory directed by Prof. Minoru Asada, Osaka.

In October 2013, Manuel Lopes, Clément Moulin-Frier and Mai Nguyen visited the Cognitive Neuroscience lab of Jacqueline Gottlieb in New York.

MANAO Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. CTP materials (2011-2015):

U. Zaragoza, U. Girona
Leader: P. Barla (*MANAO*)
This collaboration between regions on both French and Spanish sides of Pyrénées aims at studying material properties through their connections between physical and image space. Although the purpose of such a study is general in scope, we also target a particular application: the acquisition of material properties from a single image of an object of unknown shape, under unknown illumination.

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. ALTA (2011-2015):

MAVERICK, REVES
Leader: N. Holzschuch (MAVERICK)
The project ALTA aims at analyzing the light transport equations and at using the resulting representations and algorithms for more efficient computation. We target lighting simulations, either offline, high-quality simulation or interactive simulations.

7.2.1.2. "Young Researcher" IM&M (2011-2015):

IRIT
Leader: L. Barthe (IRIT)
This project aims at the definition of simple and robust tools for the modeling of 3D objects. To this end, the proposed approach consists in combining the nice mathematical properties of implicit surfaces with classical meshes.

7.2.1.3. SeARCH (2009-2013):

PFT3D Archéovision (CNRS), CEAlex (USR CNRS 3134), ESTIA
Leader: P. Reuter
Cultural Heritage (CH) artifacts often come as a set of broken fragments leading to difficult 3D puzzles and sometime impossible to solve in a real world. The project's goal is to propose solutions from on-site acquisition, 3D surface reconstruction and semi-automatic virtual reassembly, taking into account the expertise of CH scientists. This project ended officially in March 2013, and we organized a closing conference and meeting in Bordeaux. We presented the results at "ANR - Les rencontres du numérique de l'ANR" in Paris at April 17th and 18th, 2013.

7.2.2. Competitivity Clusters

7.2.2.1. LabEx CPU:

IMB (UPR 5251), LABRI (UMR 5800), Inria (CENTRE BORDEAUX SUD-OUEST), I2M (NEW UMR FROM 2011), IMS (UMR 5218), CEA/DAM
Some members of *MANAO* participate in the local initiative CPU. As it includes many thematics, from fluid mechanics computation to structure safety but also management of timetable, safety of networks and protocols, management of energy consumption, etc., numerical technology can impact a whole industrial sector. In order to address problems in the domain of certification or qualification, we want to develop numerical sciences at such a level that it can be used as a certification tool.

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. FP7 NoE - V-MusT.net (2011-2015):

partners available at http://www.v-must.net/participants
Leader: S. Pescarin (CNR - Italy)
V-MusT.net is a new European Network of Excellence dedicated to Virtual Museums. A Virtual Museum is a personalized, immersive, interactive experience that aims to enhance our understanding of the past in museums or on the Internet. The V-Must.net network enables heritage professionals around the world to connect, collaborate and advance the development and use of virtual museums.

7.3.1.2. FP7 ITN - PRISM "Perceptual Representations for Illumination, Shape and Materials" (2013-2016):

Giessen University, Université Paris-Descartes, Bilkent University, Université de Leuven, Delft University, Birmingham University, Philips and NextLimit
Leader: Roland Fleming (Giessen University)
The goal of this project is to better understand how the human visual system understands images in terms of meaningful components: How is shape perceived consistently in varying illumination conditions and for different materials? To which extent are humans able to guess the main illumination directions in a scene? What visual properties do we make use of to estimate the material an object is made of without touching it? Answering these questions will require inter-disciplinary research and collaborations.

7.3.2. Deutsche Forschungsgemeinschaft

7.3.2.1. DFG Emmy-Noether grant "Plenoptic Acquisition and Projection - Theoretical Developments and Applications" (2012-2017):

Inria
Leader: Ivo Ihrke (Inria)
This project aims to develop a comprehensive theory of the imaging process in optical-computational devices as developed in the newly emerging field of Computational Optics. The theory will be validated by a number of practical applications. It will allow for the modeling of image formation processes in measurement systems employing novel computational imaging and projection devices. This makes it possible to optimize these systems with respect to particular imaging tasks, which is currently impossible due to limited models. A further interesting aspect of the project is that computational imaging devices will become comparable with respect to parameters such as their resolution and noise characteristics which is hardly possible at the moment.

POTIOC Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

Potioc has strong relationships with Cap Sciences.

7.2. National Initiatives

FUI SIMCA 2000:

- duration: 2011-2013
- partners: Oktal, ENAC (Ecole Nationale de l'Aviation Civile), Toulouse-Blagnac airport, Air France, CGx AERO in SYS
- website: https://team.inria.fr/potioc/fr/collaborative-projects/simca/

PIA ville numérique "Villes transparentes":

- duration: 2012-2014
- partners: Pages Jaunes/Mappy, Vectuel/Virtuelcity

Inria ADT OpenViBE-NT:

- duration: 2012-2014
- partners: Inria teams Hybrid, Neurosys and Athena
- website: http://openvibe.inria.fr

Inria Project Lab BCI-LIFT:

- partners: Inria team Athena (Inria Sophia-Antipolis), Inria team Hybrid (Inria Rennes), Inria team Neurosys (Inria Nancy), LITIS (Université de Rouen), Inria team DEMAR (Inria Sophia-Antipolis), Inria team MINT (Inria Lille), DyCOG (INSERM Lyon)
- Project around BCI in the evaluation process, with collaboration just starting (first meeting with all the partners in October 2013)

7.3. European Initiatives

7.3.1. Collaborations with Major European Organizations

Collaboration with the University of Bristol, BIG (UK):

- University of Bristol, Bristol Interaction and Graphics (BIG) group, UK (Head: Pr. Sriram Subramanian)
- We have strong relationships with Sriram Subramanian. This has led to joint paper publications, numerous visits and a co-supervision of a PhD thesis (Camille Jeunet)

Bordeaux Idex project "Conception de Système d'interfaces cerveau-ordinateur prenant en compte les facteurs humains afin d'optimiser l'apprentissage de l'utilisateur:

- Bordeaux Idex funding for international PhD project
- partners: Bordeaux Segalen University (Handicap & Système nerveux team), Bristol University (BIG team)
- duration: October 2013 - September 2016

LIRA Stress and Relaxation project:

- Program: Inria - Philips - Fraunhofer partnership
- Project title: LIfe-style Research Association, Lifestyle Management: Stress and Relaxation
- Coordinator: Frederic Alexandre
- Other partners: Philips (Netherlands), Fraunhofer (Germany), Inria teams Hybrid and Mimetic
- Abstract: The Stress and Relaxation project aims at offering services to a user, at home or at work, to help this user evaluate and control his level of stress

7.4. International Initiatives

7.4.1. Inria International Partners

7.4.1.1. Informal International Partners

- Pr. Gerwin Schalk (Schalk Lab, Wadsworth center, NY, USA), Pr. Jonathan Brumberg (Kansas University, USA), Dr. Cuntai Guan (I2R, Singapore).
- Collaboration in the context of a project around the analysis of ElectroCorticoGraphic (ECoG) brain signals in order to decode speech related information from them.
- Multidisciplinary project involving experts from ECoG signals (Gerwin Schalk), speech neuroscience (Jonathan Brumberg) and speech recognition (Cuntai Guan)

7.5. International Research Visitors

7.5.1. Internships

This year, the Potioc team has hosted three PhD students

- Nicoletta Caramia, University de Pavia, Italy (Avril-July 2013)
- Asier Marzo, Universidad Pública de Navarra, Spain (August-November 2013)
- Flavio Bertini, University of Bologna, Italy (December 2013-February 2014)