



RESEARCH CENTER

FIELD

**Applied Mathematics, Computation
and Simulation**

Activity Report 2013

Section Partnerships and Cooperations

Edition: 2014-03-20

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CAD Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

Our Join Inria Tsinghua Project is located from 2004 at Tsinghua University (Beijing – China). CAD is a LIAMA Project.

CALVI Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

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

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

- GYPSI project (2010–2014), <https://sites.google.com/site/anrgypsi/>: coordinator Philippe Ghendrih (CEA Cadarache), other participants, University of Marseille, Universities of Strasbourg and Nancy (CALVI project-team). The aim is to understand the physics of turbulence in magnetically confined plasma using numerical simulation
- ANR project “PEPPSI” in Programme Blanc SIMI 9 – Sciences de l’ingénierie (Edition 2012) started in 2013. Participants : Giovanni Manfredi (coordinator), Edwin Chacon Golcher, Sever Hirstoaga.

8.1.2. Euratom-CEA projects

- Michel Mehrenberger and Philippe Helluy are local coordinators of the project FR FCM (CNRS Federation on Magnetic Confinement Fusion), within Euratom-CEA association, Title: "Numerical Methods for GYSELA", the goal is to help improving the numerical algorithms used by the GYSELA code developed at CEA Cadarache for the simulation of turbulence in magnetic fusion plasmas.
- Jean R. Roche is the coordinator of the FR FCM project with Euratom-CEA association, Title: "Full wave modeling of lower hybrid current drive in tokamaks". The goal of this project is to develop a full wave method to describe the dynamics of lower hybrid current drive problem in tokamaks.

8.2. International Research Visitors

8.2.1. Visits to International Teams

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

CONCHA Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

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8.2. National Initiatives

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8.4.2.1. Declared Inria International Partners

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8.5.1.1. Internships

8.5.2. Visits to International Teams

MICMAC Project-Team

7. Partnerships and Cooperations

7.1. International Initiatives

T. Lelièvre, G. Stoltz and F. Legoll participate to the Laboratoire International Associé (LIA) CNRS / University of Illinois at Urbana-Champaign on complex biological systems and their simulation by high performance computers. This LIA involves on the french side research teams from Université Nancy, Université de Lyon and Inria Rennes.

7.2. International Research Visitors

7.2.1. *Visits of International Scientists*

We have invited the following researchers to visit our team:

- U. Hetmaniuk (University of Washington in Seattle), April 8-12, 2013, and Dec 16-20, 2013.

SCIPORT Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

7.1.1.1. ECINADS

Sciport is coordinator of the ANR project ECINADS, with CASTOR team, university Montpellier 2, Institut de Mécanique des Fluides de Toulouse and the Lemma company in Sophia-Antipolis. ECINADS concentrates on scalable parallel solution algorithms for state and adjoint systems in CFD, and on the use of this adjoint for mesh adaptation applied to unsteady turbulent flows. ECINADS ended in november.

7.1.1.2. MAIDESC

Sciport is coordinator of the ANR project MAIDESC, with Gamma team, university Montpellier 2, Cemef-Ecole des Mines, Inria-Bordeaux, Lemma and Transvalor. MAIDESC started in october. MAIDESC concentrates on mesh adaption and in particular meshes for interfaces, third-order accuracy, meshes for boundary layers, and curved meshes.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. AboutFlow

Type: PEOPLE

Instrument: Initial Training Network

Duration: November 2012 - October 2016

Coordinator: Jens-Dominik Mueller

Partner: Queen Mary University of London (UK)

Inria contact: Laurent Hascoët

Abstract: The aim of AboutFlow is to develop robust gradient-based optimisation methods using adjoint sensitivities for numerical optimisation of flows. <http://aboutflow.sems.qmul.ac.uk/>

7.2.1.2. UMRIDA

Type:AAT

Instrument:Aeronautics and Air Transport

Duration: 2013-2016

Coordinator: Charles Hirsch

Partner: Numeca S.A. (Belgium)

Inria contact: Alain Dervieux

Abstract: UMRIDA addresses major research challenges in Uncertainty Quantification and Robust Design: develop new methods that handle large numbers of simultaneous uncertainties and generalized geometrical uncertainties. The turn-around time must be acceptable for industrial readiness. UMRIDA will apply these methods to representative industrial configurations.

7.3. International Initiatives

7.3.1. Inria International Partners

7.3.1.1. SARDINE

Program: Inria International Partner

Title: Sophia-Antipolis ARgonne DIfferentiation INitiative

Inria principal investigator: Laurent Hascoët

International Partner (Institution - Laboratory - Researcher):

Argonne National Laboratory (USA) - Math and Computer Science - Paul Hovland

Duration: 2012 - 2013

We study theoretical and computer science aspects of Automatic Differentiation (AD) by source transformation. In the context of the adjoint mode of AD, which computes gradients, we focus on the storage-recomputation tradeoffs that are the key to efficiency. We also focus on the correct AD of message-passing communication calls that are found in parallel application. A third goal is the use into Uncertainty Quantification of higher-order derivatives produced through AD. From the point of view of tool development, we aim at building interfaces to bridge between the AD tools of our teams, OpenAD and TAPENADE.

7.3.2. Inria International Labs

The team participates in the JLPC, together with our colleagues at Argonne National Laboratory. Laurent Hascoët attended the JLPC meeting in Lyon on June 12-14, and presented our works on the adjoint of MPI-II one-sided communications. The team co-organizes and will host the next JLPC meeting in June 2014 in Sophia-Antipolis.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- Jean Utke, Argonne National Laboratory (USA), March 11 to March 22.
- Michel Schanen, RWTH Aachen (Germany), March 11 to March 15.
- Trond Steihaug, from University of Bergen (Norway), June 3 to June 28.

7.4.2. Visits to International Teams

- Laurent Hascoët invited by Argonne National Laboratory (USA) from October 14th to October 25th.

SIMPAF Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Collaboration with the laser physics department (PhLAM) of Université Lille 1 (C. Besse, S. De Bièvre, M. Gazeau, and G. Dujardin)

8.2. National Initiatives

8.2.1. Collaborations within Inria

REO (A. Gloria)
 COFFEE (E. Creusé and C. Calgaro)
 POEMS (C. Besse and I. Lacroix-Violet)
 CORIDA (C. Besse)
 IPSO (C. Besse)

8.2.2. ANR

8.2.2.1. ANR IODISSEE (2009-2013)

Participants: Christophe Besse, Pauline Lafitte.

C. Besse has obtained a 4-years ANR grant, from the Cosinus proposal, for the project IODISSEE. P. Lafitte and C. Yang, also members of the EPI Simpaf, are involved in this project. The project IODISSEE also involves a team of mathematicians from Toulouse, a physicist team from Versailles and the Thales group. It deals with the elaboration of a physical model for helping the industrial partner for the new generation of Galileo satellites. For the last decade, satellite positioning devices became one of the most interesting means of navigation for the displacement of the goods and the people. The only current solution is based on the constellation of satellites Navstar GPS American system. Originally developed for military applications, its use was released under the Clinton administration. However, in order to guarantee its autonomy, Europe decided to launch a competitor program known as Galileo. Galileo system differs from the GPS thanks to its capability to provide real time integrity information to the user. In order to guarantee the stability of this system, it is fundamental to take into account the various problems which can affect the mission and to identify all the potential sources of system unavailability. One of the main source of data unavailability that has been identified is the phenomena of ionospheric scintillations. Indeed scintillation causes radio frequency signal amplitude fades and phase variations as satellite signals pass through the ionosphere. Such effects may induce loss of lock or cycle slips on ranging signals broadcast by Galileo satellites making them totally useless for accurate integrity information determination. Scintillations are clearly identified like a source of disturbances. They appear as the turbulent aspect of a larger disturbance of the ionospheric plasma density which have the shape of a plasma bubble. The difficulty of their modelling is due to the lacks of in situ measurements with regard to them. However, some measurements recently acquired during the mission of satellite DEMETER make possible on the one hand the validation of the models existing but also, using techniques of data-models coupling, to reinforce them. The object of this proposal is therefore to provide a physical model making it possible to anticipate the attenuation of the signals during their propagation within the disturbed Earth ionosphere.

8.2.2.2. ANR AMAM (2011-2014)

Participant: Antoine Gloria.

A. Gloria is involved in the 4-year ANR project “young researcher” AMAM, led by V. Millot (Paris 7). The aim of the project is to develop mathematical tools for the analysis of multiscale problems in material sciences (PDEs and variational methods). The fields of interest are primarily micromagnetics, dislocations, fatigue in nonlinear elasticity, and homogenization.

8.2.2.3. ANR STAB (2013-2017)

Participant: Pauline Lafitte.

STAB : Most of the natural time-evolving systems that one encounters in Physics, Biology, Economics..., can be described by means of evolution equations, or systems of such equations. These equations may include randomness or not. During the last decade, a lot of progress has been made in the understanding of the stabilization of these dynamics, i.e. their convergence to equilibrium. In particular the picture of the qualitative description of the rate of convergence is now almost complete for symmetric models (reversible dynamics). However, the non-reversible setting is still insufficiently understood. One of the most fascinating features of this research area is the strong intricacy between the analysis of partial differential equations and stochastic methods, each approach enlightening the other one. The main goal of this project is to go further, developing tractable and efficient tools, in particular for numerical schemes and algorithms, based on the computation of explicit theoretical bounds. Hence, even if part of the project is devoted to the theoretical study of non-reversible or highly degenerate situations (we typically have to face kinetic or reaction-diffusion models for example), the heart of the project will include discretization schemes, approximating particle systems and concrete simulation situations (including boundary conditions). This concerns the stability of the discretization or numerical methods. The acronym STAB covers both aspects: stabilization and stability. Indeed, sensitivity to small perturbations (or to boundary conditions) is the first definition of large time stability for numerical schemes. The head of the project is I. Gentil (Univ. Lyon1).

8.2.2.4. ANR BECASIM(2013-2017)

Participants: Christophe Besse, Guillaume Dujardin, Ingrid Lacroix-Violet.

C. Besse, G. Dujardin, and I. Lacroix-Violet are members of the new 4-years ANR "Modèles Numériques" project BECASIM. C. Besse is the Toulouse-node coordinator and I. Lacroix-Violet the Lille-node one. The scientific subject deals with mathematical modelling, numerical analysis and simulation of Bose-Einstein condensates (BEC). The goal of this ANR project is to : (i) develop new high-order numerical methods; (ii) develop an integrated and resilient open-source HPC software; (iii) apply these codes to numerically reproduce realistic physical configurations that are not possible to simulate with presently existing software.

8.2.3. Competitivity Clusters

8.2.3.1. LABEX Centre Européen pour les Mathématiques, la Physique et leurs Interactions – CEMPI (2012-2019)

The “Laboratoire d’Excellence” CEMPI was created by the French government within the framework of its “Projets d’Investissement d’Avenir” program, in February 2012. It is a joint venture of the Laboratoire Paul Painlevé (mathematics) and the Laboratoire Physique des Lasers, Atomes et Molécules (PhLAM). Several members of CEMPI participate actively in the CEMPI research and training project, notably through the focus area “The interaction of mathematics and physics”. The corresponding research is described in Sections 3.2.3 and 3.4 .

8.3. European Initiatives

8.3.1. FP7 Projects

ERC starting grant QUANTHOM (starting February 2014).

8.3.2. Collaborations with Major European Organizations

Felix Otto: Max Planck Institute for Mathematics in the Sciences (Germany)
Quantitative stochastic homogenization theory.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- J.-C. Mourrat (EPFL, 1 week)
- D. Marahrens (MPIMS, 1 week)
- S. Neukamm (WIAS, 1 week)

8.4.2. Visits to International Teams

- A. Gloria, from September to December 2013, Math department, Stanford University

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 surface 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 Sciences 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 Heterogeneous 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 für 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 Netherlands), ONERA (France), TSAGI (Russia), ENSAM (France), Imperial College (UK), Universities of Bergamo (Italy), Warsaw (Poland), Poznan (Poland), Linköping (Sweden), Université Catholique 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 turbulent 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), TECHSPACE 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 remainder 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 (Kyoto University, Japan), E. Audit (CEA, France), E. Caron (Ecole Normale Supérieure 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 méthodes 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 méthodes de pénalisation adaptées aux maillages non-structurés fortement anisotropiques et utilisation de l'adaptation de maillage. Supervisor : H. Beaugendre ;
- Nassim RAZAALY. From February 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 NO_x emissions up to 80% only 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 NO_x 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 NO_x 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 project 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.

DEFI Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- J.R. Li is the coordinator of the project Simulation du signal d'IRM diffusion dans des tissus biologiques (SIMUDMRI), funded 2010-2013 by the ANR Program COSINUS. Participants : Jing-Rebecca Li, Housseem Haddar, Dang Van Nguyen. Joint proposal between Inria-Saclay and CEA Neurospin. <http://www.cmap.polytechnique.fr/~jingrebeccali/grants/simudmri.html>
- H. Haddar is the DEFI coordinator of the ANR: Modelization and numerical simulation of wave propagation in metamaterials (METAMATH), program MN, 2011-2015. This is a joint ANR with POEMS, Inria Saclay Ile de France project team (Coordinator, S. Fliss), DMIA, Département de Mathématiques de l'ISAE and IMATH, Laboratoire de Mathématiques de l'Université de Toulon. <https://www.rocq.inria.fr/poems/metamath>
- J.R. Li is the coordinator of the Inria partner of the project "Computational Imaging of the Aging Cerebral Microvasculature", funded by ANR Program "US-French Collaboration". French Partners (Coordinating partner CEA Neurospin): CEA Neurospin (Coordinator Luisa Ciobanu), Inria Saclay (Coordinator Jing-Rebecca Li). US Partner: Univ of Illinois, bioengineering department (Coordinator Brad Sutton). Duration: Sept 2013- Sept 2016.

8.2. European Initiatives

8.2.1. Collaborations with Major European Organizations

Partner 1: University of Bremen, Department of Math. (Germany)

Joint PhD advising of T. Rienmuller, partly funded by French-German university. Correspondant: Armin Lechleiter.

Partner 2: University of Goettingen, Department of Math. (Germany)

Development of conformal mapping method to electrostatic inverse problems. Correspondant: Rainer Kress.

Partner 3: University of Genova, Department of Math. (Italy)

Development of qualitative methods in inverse scattering problems. Correspondant: Michele Piana.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. ISIP

Title: Inverse Scattering and Identification Problems

Inria principal investigator: Housseem HADDAR

International Partner (Institution - Laboratory - Researcher):

University of Delaware (United States) - Mathematical Department - Housseem HADDAR

Duration: 2008 - 2013

See also: <http://www.cmap.polytechnique.fr/~defi/ISIP/isip.html>

8.3.2. Inria International Partners

8.3.2.1. Declared Inria International Partners

- Mathematical department of the University of Delaware

8.3.3. Participation In other International Programs

- H. Haddar is member of the EPIC, an Inria team in the framework of LIRIMA.
- Olivier Pantz is in charge of the french side of the PHC (Hubert Curien Project) *Sur l'étude de quelques problèmes d'équations aux dérivées partielles issus de la physique* (with H. Zorgati of the University of Tunis in charge for the Tunisian side).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Sabbatical

- Yassine Boubendir, Department of Mathematical Sciences, New Jersey Institute of Technology (October-December 2013)

8.4.1.2. Internships

- Thi-Phong Nguyen (March-August 2013)
- Mohamed Lakhel (February-June 2013)
- Ahmed Aaddaj Eloudrhiri February 2013-June 2013
- Isaac Harris May 2013-July 2013
- Shixu Meng May 2013-August 2013
- Khieu Van NGUYEN, April-July 2013.

GAMMA3 Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR

F. Alauzet, N. Barral, V. Menier and A. Loseille are part of the MAIDESC ANR (2013-2015) on mesh adaptation for moving interfaces in CFD.

6.1.2. Autres sections...

P. Laug participated in the Inria collaboration program GEOFRAC: *Large-scale computation of flow in complex 3D geological fractured porous media*. Its coordinator is J. Erhel, SAGE team, Inria Rennes (January 2012 - June 2013). The teams involved are GAMMA3, POMDAPI, SAGE (Inria) and UMR Géosciences Rennes.

6.2. European Initiatives

6.2.1. FP7 Projects

F. Alauzet, N. Barral, V. Menier and A. Loseille are part of the UMRIDA FP7 program (2013-2017) devoted to the control of uncertainties in CFD.

IPSO Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR Programme blanc GYPSI: 2010-2014

Participant: Nicolas Crouseilles.

Leader: Ph. Gendrih.

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

6.1.2. ANR Programme blanc E2T2: 2010-2014

Participant: Nicolas Crouseilles.

Leader: P. Beyer

6.1.3. ANR Programme blanc STOSYMAP

Participant: Arnaud Debussche.

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

6.2. European Initiatives

6.2.1. FP7 Projects

6.2.1.1. Geopardi

Title: Geometric Partial Differential Equations

Type: IDEAS ()

Instrument: ERC Starting Grant (Starting)

Duration: September 2011 - August 2016

Coordinator: Inria (France)

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

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

6.2.2. Collaborations in European Programs, except FP7

ANR Programme blanc international (BLAN)

LODIQUAS 2012-2015

Low DIMensional QUANtum Systems

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

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

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

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

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

6.3. International Initiatives

6.3.1. Participation In other International Programs

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

6.4. International Research Visitors

6.4.1. Visits of International Scientists

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

6.4.2. Visits to International Teams

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

- N. Crouseilles visited the group of E. Sonnendrücker (IPP Garching, Germany), one week (december 2012).
- N. Crouseilles and E. Faou visited the group of A. Ostermann (University of Innsbrück, Austria), one week (march 2013).
- N. Crouseilles visited the group of P. Coelho (Universitat tecnico de Lisboa, Portugal), one week (july 2013).
- N. Crouseilles and M. Lemou visited the group of R. Raghurama (Indian Institute of Sciences, Bangalore (India)), 2 weeks (december 2013).

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 electroporomeabilization by nanopulses at the subcellular level. The goal is to develop new electrical devices and accurate models to understand the electroporomeabilization 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 beginning 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 electroporomeabilization 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 electroporomeabilization 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, Franhofer.
- 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, Université 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-oncology and mathematics, University of Alabama at Birmingham. We work on numerical modeling of brain tumor.
- Collaborations with Luca Zannetti, Politecnico di Torino; Simone Camarri, Università 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-angiogenic 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.

MOKAPLAN Exploratory Action

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

Jean-David Benamou is the coordinator of the ANR ISOTACE (Interacting Systems and Optimal Transportation, Applications to Computational Economics) ANR-12-MONU-0013 (2012-2016). The consortium explores new numerical methods in Optimal Transportation AND Mean Field Game theory with applications in Economics and congested crowd motion. Four extended seminars have been organized/co-organized by Mokaplan. Check <https://project.inria.fr/isotace/news>.

Christophe Duquesne (Aurigotech) is a software and mobility consultant hired on the ANR budget. He helps the consortium to develop its industrial partnerships.

7.2. International Initiatives

7.2.1. Informal International Partners

Mokaplan has strong links with several Canadian researchers (Oberman, Froese, Agueh, Pass). In July 2013, Oudet, Carlier, Agueh, Pass, Oberman, Froese and Benamou gathered in Banff for a "focussed research group" week :

<http://www.birs.ca/events/2013/focussed-research-groups/13frg167>. The meeting was productive and several new collaborations were started on the occasion which are listed in the objectives of this proposal.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

- Brendan Pass (U. of Alberta).
- Brittany Froese (U. Texas at Austin).
- Giuseppe Buttazzo (U. Pisa).

7.3.1.1. Internships

- Nicolas Bonne extended the ALG2 used in the CFD approach to Optimal Mass Transportation to build a numerical method for Mean Field Games models.

NACHOS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Inria Project Lab

8.1.1.1. C2S@Exa - Computer and Computational Sciences 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 coordinating 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. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. DEEP-ER

Type: COOPERATION

Defi: Exascale computing platforms, software and applications

Instrument: Integrated Project

Objectif: Dynamic Exascale Entry Platform - Extended Reach

Duration: October 2013 - September 2016

Coordinator: Forschungszentrum Juelich GmbH (Germany)

Partner: Intel GmbH (Germany), Bayerische Akademie der Wissenschaften (Germany), Ruprecht-Karls-Universität Heidelberg (Germany), Universität Regensburg (Germany), Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung E.V (Germany), Eurotech Spa (Italy), Consorzio Interuniversitario Cineca (Italy), Barcelona Supercomputing Center - Centro Nacional de Supercomputación (Spain), Xyratex Technology Limited (United Kingdom), Katholieke Universiteit Leuven (Belgium), Stichting Astronomisch Onderzoek in Nederland (The Netherlands) and Inria (France).

Inria contact: Stephane Lanteri

Abstract: the DEEP-ER project aims at extending the Cluster-Booster Architecture that has been developed within the DEEP project with a highly scalable, efficient, easy-to-use parallel I/O system and resiliency mechanisms. A Prototype will be constructed leveraging advances in hardware components and integrate new storage technologies. They will be the basis to develop a highly scalable, efficient and user-friendly parallel I/O system tailored to HPC applications. Building on this I/O functionality a unified user-level checkpointing system with reduced overhead will be developed, exploiting multiple levels of storage. The DEEP programming model will be extended to introduce easy-to-use annotations to control checkpointing, and to combine automatic re-execution of failed tasks and recovery of long-running tasks from multi-level checkpoint. The requirements of HPC codes with regards to I/O and resiliency will guide the design of the DEEP-ER hardware and software components. Seven applications will be optimised for the DEEP-ER Prototype to demonstrate and validate the benefits of the DEEP-ER extensions to the Cluster-Booster Architecture.

8.2.2. Collaborations with Major European Organizations

Prof. Martin Gander: University of Geneva, Mathematics section (Switzerland)

Domain decomposition methods (optimized Schwarz algorithms) for the solution of the frequency domain Maxwell equations

Dr. Maciej Klemm: University of Bristol, Communication Systems & Networks Laboratory, Centre for Communications Research (United Kingdom)

Numerical modeling of the propagation of electromagnetic waves at the nanoscale for biomedical applications

8.3. International Initiatives

8.3.1. Participation In other International Programs

8.3.1.1. CNPq-Inria HOSCAR project

Participants: Reza Akbarinia [ZENITH project-team, Inria Sophia Antipolis - Méditerranée], Rossana Andrade [CSD/UFC], Hélène Barucq [MAGIQUE3D project-team, Inria Bordeaux - Sud-Ouest], Alvaro Coutinho [COPPE/UFR], Juklien Diaz [MAGIQUE3D project-team, Inria Bordeaux - Sud-Ouest], Thierry Gautier [MOAIS project-team, Inria Grenoble - Rhone-Alpes], Antônio Tadeu Gomes [LNCC], Pedroedro Leite Da Silva Dias [LNCC, Coordinator of the project on the Brazilian side], Luc Giraud [HIEPACS project-team, Inria Bordeaux - Sud-Ouest], Stéphane Lanteri [Coordinator of the project on the French side], Alexandre Madureira [LNCC], Nicolas Maillard [INF/UFRG], Florent Maseglia [ZENITH project-team, Inria Sophia Antipolis - Méditerranée], Marta Mattoso [COPPE/UFR], Philippe Navaux [INF/UFRG], Esther Pacitti [ZENITH project-team, Inria Sophia Antipolis - Méditerranée], François Pellegrini [BACCHUS project-team, Inria Bordeaux - Sud-Ouest], Fabio Porto [LNCC], Bruno Raffin [MOAIS project-team, Inria Grenoble - Rhone-Alpes], Pierre Ramet [HIEPACS project-team, Inria Bordeaux - Sud-Ouest], Jean-Louis Roch [MOAIS project-team, Inria Grenoble - Rhone-Alpes], Patrick Valduriez [ZENITH project-team, Inria Sophia Antipolis - Méditerranée], Frédéric Valentin [LNCC].

Since July 2012, the team is coordinating the HOSCAR <http://www-sop.inria.fr/hoscar> Brazil-France collaborative project. The HOSCAR project is a CNPq - Inria collaborative project between Brazilian and French researchers, in the field of computational sciences. The project is also sponsored by the French Embassy in Brazil.

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). Several Brazilian institutions are participating to the project among which: LNCC (Laboratório Nacional de Computação Científica), COPPE/UFRJ (Instituto Alberto Luiz Coimbra de Pós-Graduação e Pesquisa de Engenharia/Alberto Luiz Coimbra Institute for Graduate 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 Computação Departamento de Computação, Universidade Federal do Ceará). The French partners are research teams from several Inria research centers.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Prof. Kurt Busch, Theoretical Optics & Photonics, Humboldt-Universität zu Berlin, July 4-5

Prof. Martin Gander, University of Geneva, Switzerland, July 1-12

Prof. Jay Gopalakrishnan, Portland University, USA, July 15-19

Dr. Maciej Klemm, University of Bristol, UK, July 29-August 2

Dr. Antoine Moreau, Institut Pascal, Université Blaise Pascal, June 11-12

8.4.1.1. Internships

Anis Ben El Haj Midani Mohamed, ENIT-LAMSIN, Tunisia, April 30-July 31

Nicole Olivares, Mathematics Department, Portland University, Oregon, USA, June 11-August 21

8.4.2. Visits to International Teams

Stéphane Lanteri, School of Mathematical Sciences, Institute of Computational Sciences, University of Electronic Science and Technology of China Chengdu, June 2-7

Stéphane Lanteri, Laboratory for Computational Mathematics, Center of Mathematics, and Institute for Biomedical Imaging and Life Sciences, Coimbra University, Portugal, October 27-November 1

NANO-D Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

- **ARC 2012:** This grant from the Rhone-Alpes region (<http://www.arc.rhonealpes.fr/>) has been provided to S. Redon, Jean-François Méhaut (LIG - Laboratoire d'Informatique de Grenoble) and Benjamin Bouvier (IBCP - Institut de Biologie et Chimie des Proteines) to develop adaptive, parallel algorithms for molecular simulation. The grants is for a PhD student.

6.2. National Initiatives

6.2.1. ANR

In 2013, NANO-D had funding from four ANR programs:

- **ANR Jeunes Chercheurs Jeunes Chercheuses (JCJC):** 340,000 Euros over three years (2011-2014). This grant has been provided to S. Redon by the French Research Agency for being a finalist in the ERC Starting Grant 2009 call, and is for two PhD students and an engineer.
- **ANR Modeles Numeriques (MN):** 180,000 Euros over four years (2011-2015). This project, coordinated by NANO-D (S. Grudinin), gathers biologists and computer scientists from three research groups: Dave Ritchie at LORIA, Valentin Gordeliy at IBS (total grant: 360,000 Euros).
- **ANR PIRIBio:** 25,000 Euros over four years (2010-2013). We are participating in this project coordinated by Michel Vivaudou at IBS, with Serge Couzy at CEA/LCBM and Frank Fieschi at IBS.

6.2.2. PEPS

Sergei Grudinin participates in the Cryo-CA PEPS project. Cryo-CA (Computational algorithms for biomolecular structure determination by cryo-electron microscopy) is a 2-years project, supported by the Projets Exploratoires Pluridisciplinaires (PEPS) program in the panel Bio-Maths-Info provided by CNRS (French National Centre for Scientific Research). The project started on the 01/09/2012. Its main goal is to develop computational algorithms for cryo-electron microscopy (cryo-EM).

The partners of the Cryo-CA project are: Inria Nancy / Team Orpailleur (David Ritchie); Inria Grenoble / Team NANO-D (Sergei Grudinin); and INSERM IGBMC/ Team Integrated structural Biology (Annick Dejaegere, Patrick Schultz, and Benjamin Schwarz).

The main scientific aim of this cross-disciplinary project is to develop computational algorithms to help experimentalists and molecular modelers to solve more rapidly and accurately the structures of macromolecular complexes using cryo-electron microscopy (cryo-EM) and integrative structural biomolecular modeling techniques. More specifically, this PEPS initiative aims to address two important challenges in single particle cryo-EM, namely particle picking and multi-dimensional structure fitting. In the longer term, a further driving aim of this project is to develop strong collaborations amongst the participating teams to position ourselves for a larger project proposal to ANR or ERC.

6.3. European Initiatives

6.3.1. FP7 Projects

6.3.1.1. ADAPT

Type: IDEAS

Defi: NC

Instrument: ERC Starting Grant

Objectif: Theory and algorithms for adaptive particle simulation

Duration: September 2012 - August 2017

Coordinator: Stephane Redon

Inria contact: Stephane Redon

6.4. International Initiatives

6.4.1. Inria International Partners

6.4.1.1. Informal International Partners

NANO-D has an ongoing collaboration with the research group of Pr. Dr. Markus Reiher in ETH Zürich, to develop interactive quantum chemistry methods assisted with haptic feedback.

6.5. International Research Visitors

6.5.1. Visits of International Scientists

- Pr. Dr. Markus Reiher, from ETH Zürich, visited NANO-D in January 2013
- Pr. Eric Polizzi, from the University of Massachusetts Amherst, visited NANO-D in March 2013
- PhD students Moritz Haag and Arndt Finkelmann, from the Reiher group at ETH Zürich, visited NANO-D in October 2013

6.5.1.1. Internships

Astha Agarwal

Subject: Development of a Coarse-Grained Potential Function for Protein Folding and De Novo Design

Date: from May 2013 until Jul 2013

Institution: IIT Bombay (India)

OPALE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. Project "OMD2", *Optimisation Multi-Disciplinaire Distribuée (Distributed Multidisciplinary Optimization)*

This project funded by ANR deals with the development of a software platform devoted to Multidisciplinary Design Optimization (MDO) in the context of distributed computing.

The notion of optimization platform based on distributed and parallel codes is undertaken with a distributed workflow management system running on a grid infrastructure using the GRID5000 middleware from Inria.

Renault is the coordinator of this project, which involves also EMSE, ENS Cachan, EC Nantes, Université de Technologie de Compiègne, CD-Adapco, Sirehna, Activeon, and Inria project Tao, Oasis and Opale. This contract provides the grant supporting two PhD theses (A. Zerbinati and L. Trifan)

8.1.2. Project "OASIS"

The OASIS project, Optimization of Addendum Surfaces In Stamping, is an R&D consortium (CS, Arcelor-Mittal, ErDF, Inria, UTC, EURODECISION, ESILV, NECS, DeltaCAD, SCILAB-DIGITEO) of the Pole Systemic Paris-Region dedicated to develop an optimal design framework (methods-software platforms-applications) for stamping processes. The EPI OPALE/Inria is the leader within the consortium for the Optimization work-package (one of six WP), the role of which is to develop efficient tools well adapted to Pareto front identification of the multicriteria-dependent stamping processes.

The OASIS project yields 2.4 Meuro total financial support (one Ph.D thesis, two post-doctoral positions and 12 months internship for OPALE).

8.1.3. Project "Memoria"

This project is funded by the National Foundation for Aeronautics and Space (FNRAE). The partners are the University of Toulouse Paul-Sabatier and the CERFACS. The objective is to study optimization methods under uncertainty in the context of aerodynamic problems.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. MARS

Title: Manipulation of Reynolds Stress

Type: COOPERATION (TRANSPORTS)

Instrument: Specific Targeted Research Project (STREP)

Duration: October 2010 - September 2013

Coordinator: CENTRE INTERNACIONAL DE METODES NUMERICES EN ENGINYERIA (Spain)

Others partners: USFD (UK), AIRBUS (SP), FOI (SW), ALENIA (IT), DLR (GER), CNRS (FR), DASSAULT (FR), NUMECA (BEL), UNIMAN (UK), EADS (UK)

See also: <http://www.cimne.com/mars/>

Abstract: The objective is to study flow control devices for aeronautical applications. This project gathers twelve European partners and twelve Chinese partners for a common work that includes both experimental and numerical studies. Opale project-team is in charge of developing numerical algorithms to optimize flow control devices (vortex generators, synthetic jets).

8.2.1.2. *GRAIN 2*

Type: COOPERATION

Defi: Transport (incl. Aeronautics)

Instrument: Coordination and Support Action (CSA)

Duration: October 2013 - September 2015

Coordinator: CENTRE INTERNACIONAL DE METODES NUMERICES EN ENGINYERIA (Spain)

Partner: AIRBUS (SP), ALENIA (I), EADS-IW (F), Rolls-Royce (UK), INGENIA (SP), NUMECA (B), U. SHEFFIELD (UK), U. BIRMINGHAM (UK), CIRA (I), VKI (B), AIRBORNE (NL), LEITAT (SP), CERFACS (F), U. CRANFIELD (UK), CAE (CN), GTE (CN), ARI (CN), FAI (CN), ASRI (CN), SAERI (CN), BIAM (CN), ACTRI (CN), BUAA (CN), NPU (CN), PKU (CN), NUAU (CN), ZJU (CN).

See also: <http://www.cimne.com/grain2/>

Inria contact: Toan Nguyen

Abstract: The main objective of GRAIN2 is to focus its greening activities following the Flight Path 2050 Vision for Aircraft en route to the very ambitious challenge "Protecting the environment and the energy supply" in three major following lines: i) greening the air vehicle, ii) greening the Air transport System and iii) Reducing the carbon foot print of aviation via sustainable alternative fuels. GRAIN2 will identify innovative R & D methods, tools and HPC environments (supercomputers and GPGPUs) in the different KGTs according to the needs of major aeronautical industries to deeper understand the mechanism of engine exhaust emissions, to improve fuel efficiency and environmental performance, to lower noise for landing gear and high lift surfaces, to introduce new materials with multiple functions, to help significantly the development of biofuels for greenhouse gas emission reduction, etc.

8.2.1.3. *TraM3*

Type: IDEAS

Title: TRaffic Management by Macroscopic Models

Instrument: ERC Starting Grant

Objectif: NC

Duration: October 2010 - September 2015

Coordinator: Inria

Inria contact: Paola Goatin

Abstract: The project intends to investigate traffic phenomena from the macroscopic point of view, using models derived from fluid-dynamics consisting in hyperbolic conservation laws. The scope is to develop a rigorous analytical framework and fast and efficient numerical tools for solving optimization and control problems, such as queues lengths control or buildings exits design. See also: <http://www-sop.inria.fr/members/Paola.Goatin/tram3.html>

8.2.2. *Collaborations in European Programs, except FP7*

Program: KIC EIT ITC Labs, IMTS Intelligent Mobility and Transportation Systems

Project title: Multimodal Mobility

Duration: January 2013 - December 2013

Coordinator: Françoise Baude (Inria/UNS), Birgit Kwella (Fraunhofer Fokus)

Other partners: TU Berlin, U. Bologna, Inria, BME, Fraunhofer Gesellschaft, Telecom Italia, Siemens

Abstract: Identify innovation levers and possible joint developments in IMS

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. ORESTE

Title: Optimal RERoute Strategies for Traffic managEment

Inria principal investigator: Paola Goatin

International Partner (Institution - Laboratory - Researcher):

University of California Berkeley (United States) - Electrical Engineering and Computer Science (EECS) - Paola Goatin

Duration: 2012 - 2014

See also: <http://www-sop.inria.fr/members/Paola.Goatin/ORESTE/index.html>

ORESTE is an associated team between OPALE project-team at Inria and the Mobile Millennium / Integrated Corridor Management (ICM) team at UC Berkeley focused on traffic management. With this project, we aim at processing GPS traffic data with up-to-date mathematical techniques to optimize traffic flows in corridors. More precisely, we seek for optimal reroute strategies to reduce freeway congestion employing the unused capacity of the secondary network. The project uses macroscopic traffic flow models and a discrete approach to solve the corresponding optimal control problems. The overall goal is to provide constructive results that can be implemented in practice. Both teams have actively contributed to recent advances in the subject, and we think their collaboration is now mature enough to take advantage of the associate team framework. The Inria team and its theoretical knowledge complement the Berkeley team, with its engineering knowledge anchored in practice.

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

Jean-Antoine Désidéri maintains close links with Prof. Alfio Borzì (Institut für Mathematik - Universität Würzburg, Germany) on theme of PDE-constrained optimization.

Régis Duvigneau maintains active cooperation with Praveen Chandrashkar (formely Opale post-doctoral fellow, now Assistant Professor at Tata Institute for Fundamental Research, Bangalore, Dept. Applicable Mathematics) on the theme of shape optimization in aerodynamics.

Additionally, Abderrahmane Habbal has a long term thorough collaboration with Moez Kallel from ENIT, Tunis, focusing on new applications of game theory to inverse problems and imaging science. We also have a continuing intensive collaboration with Rajae Aboulaich and Rachid Ellaia, from EMI, Rabat, and their collaborators. The themes addressed are multiobjective optimization, and mathematical modeling in life sciences.

8.3.3. Inria International Labs

- LIRIMA Team ANO 2010-2014:

The agreement governing the creation of the International Laboratory for Research in Computer Science and Applied Mathematics (LIRIMA) was signed on 24th November 2009 in Yaoundé. LIRIMA enables cooperation between Inria research teams and teams in Africa (Sub-Saharan Africa and the Maghreb) to be reinforced. It is the continuation of the major operation undertaken by the SARIMA program (2004-08 Priority Solidarity Fund created by the French Ministry of Foreign & European Affairs).

The LIRIMA team ANO : Numerical analysis of PDEs and Optimization is a partnership between Opale project and the EMI engineering college, Rabat / National Centre for Scientific and Technical Research (CNRST) Morocco. The Team leader is Prof. Rajae Aboulaïch, EMI. Other French participants are the Project Commands at Saclay, Palaiseau and the team-project DRACULA at Inria Lyon.

The ANO team is composed of ten senior researchers from Morocco and ten senior researchers from France and more than fifteen PhD students.

The themes investigated are biomathematics (Models for plants growth, cardiovascular and cerebral diseases, cardio image segmentation), mathematical finance (optimal portfolio, risk management, Islamic finance), multiobjective optimization in structural mechanics, and vehicle traffic and crowd motion. Refer to the website <http://www.lirima.uninet.cm/index.php/en/> for more details on the LIRIMA Africa themes and teams.

8.3.4. Participation In other International Programs

- Inria@SILICONVALLEY :
ORESTE Associated Team with UC Berkeley takes part to the program.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Senior Researchers

Pr. Ellaia Rachid

Subject: Theory and algorithms for global and multiobjective optimization.

Institution: Ecole Mohammadia d'Ingénieurs (EMI) , Rabat (Morocco)

8.4.1.2. PhD Students

Legesse Lemecha Obsu

Subject: Macroscopic traffic flow optimization on roundabouts.

Institution: University of Addis Ababa (Ethiopia)

8.4.1.3. Internships

Bouthaina Yahyaoui, Asma Ghdami and Marwa Mokni

Subject: Multiobjective optimization of laminated composite Mindlin-Reissner plates

Institution: Institut Supérieur des Mathématiques Appliquées et d'Informatique, Kairouan, (Tunisia)

POEMS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- ANR project *AEROSON: Simulation numérique du rayonnement sonore dans des géométries complexes en présence d'écoulements réalistes*
Partners: EADS-IW, CERFACS, Laboratoire d'Acoustique de l'Université du Maine.
Start : 10/01/2009, End : 02/28/2013. Administrator : CNRS. Coordinator : Jean-François Mercier.
- ANR project *PROCOMEDIA: Propagation d'ondes en milieux complexes*
Partners: ESPCI, Laboratoire d'Acoustique de l'Université du Maine, Departamento de Fisica de la Universidad de Chile.
Start : 04/01/2011, End : 03/30/2014. Administrator : CNRS. Coordinator for POEMS : Jean-François Mercier.
- ANR project *METAMATH: modélisation mathématique et numérique pour la propagation des ondes en présence de métamatériaux*. Partners: EPI DEFI (Inria Saclay), IMATH-Université de Toulon, DMIA-ISAE.
Start : 12/01/2011, End : 11/30/2015. Administrator : Inria. Coordinator : Sonia Fliss.
- ANR project *CHROME: Chauffage , réflectométrie et Ondes pour les plasmas magnétiques* Partners: Université Pierre et Marie Curie (Paris 6), Université de Lorraine
Start : 10/01/2012, End : 10/01/2015 Administrator : Inria Coordinator for POEMS: Eliane Bécache
- ANR project *SODDA: Diagnostic de défauts non francs dans les réseaux de câbles* Partners: CEA LIST, ESYCOM, LGEP (Supelec)
Start : 10/01/2012, End : 10/01/2015 Administrator : Inria Coordinator for Poems: Patrick Joly
- ANR project *RAFFINE: Robustesse, Automatisation et Fiabilité des Formulations INTégrales en propagation d'ondes : Estimateurs a posteriori et adaptivité* Partners: CERFACS, EADS, IMACS, ONERA, Thales
Start : January 2013. End : december 2016. Administrator : Inria. Coordinator: Marc Bonnet.
- ANR project *ARAMIS: Analyse de méthodes asymptotiques robustes pour la simulation numérique en mécaniques* Partners: Université de Pau, Université technologique de Compiègne
Start : january 2013. End : december 2016. Administrator : Université de Pau. Participants for POEMS: Marc Bonnet

8.1.2. Competitivity Clusters

- GDR Ultrasons: this GDR, which regroups more than regroup 15 academic and industrial research laboratories in Acoustics and Applied Mathematics working on nondestructive testing. It has been renewed this year with the participation of Great Britain.

8.2. European Initiatives

8.2.1. FP7 Project : SIMPOSIUM

Title: Simulation Platform for Non Destructive Evaluation of Structures and Materials

Type: COOPERATION (ICT)

Defi: PPP FoF: Digital factories: Manufacturing design and product lifecycle manage

Instrument: Integrated Project (IP)

Duration: September 2011 - August 2014

Coordinator: CEA (Pierre Calmont) (France)

See also: <http://cordis.europa.eu/fetch?CALLER=PROJECT&ACTION=D&CAT=PROJ&RCN=99653>

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- *Sergei Nazarov*, Professor at the University of Saint-Petersbourg.

APICS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

The ANR (Astrid) project COCORAM (Co-design et co-intégration de réseaux d'antennes actives multi-bandes pour systèmes de radionavigation par satellite) has been accepted and will officially start January 2014. We are associated in this project with three other teams from XLIM (Limoges University), specialized respectively on filters, antennas and amplifiers. The core idea of the project is to work on the co-integration of various microwave devices in the context of GPS satellite systems and in particular for us to work on matching problems (see Section 6.3.1).

8.2. European Initiatives

8.2.1. Collaborations with Major European Organizations

APICS is part of the European Research Network on System Identification (ERNSI) since 1992.

Subject: System identification concerns the construction, estimation and validation of mathematical models of dynamical physical or engineering phenomena from experimental data.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. IMPINGE

Title: Inverse Magnetization Problems IN GEosciences.

Inria principal investigator: Laurent Baratchart

International Partner (Institution - Laboratory - Researcher):

MIT - Department of Earth, Atmospheric and Planetary Sciences (United States) - Benjamin Weiss

Duration: 2013 - 2015

See details at : <http://www-sop.inria.fr/apics/IMPINGE/>

The purpose of the associate team IMPINGE is to develop efficient algorithms to recover the magnetization distribution of rock slabs from measurements of the magnetic field above the slab using a SQUID microscope (developed at MIT). The US team also involves a group at Vanderbilt Univ.

8.3.2. Inria International Partners

8.3.2.1. Declared Inria International Partners

NSF CMG collaborative research grant DMS/0934630, "Imaging magnetization distributions in geological samples", with Vanderbilt University and the MIT (USA).

Cyprus NF grant "Orthogonal polynomials in the complex plane: distribution of zeros, strong asymptotics and shape reconstruction".

PHC Utique CMCU (led by Fédération Denis Poisson, Univ. Orléans), "Harmonic analysis and applications".

8.3.2.2. Informal International Partners

As mentioned in Sections 5.6 and 6.1.1, a cooperation with the German firm BESA⁴ has started this year, which includes Athena Team (Inria Sophia-Antipolis-Méditerranée) and Centre de Mathématiques Appliquées of École des Mines de Paris. It is expected to be formalized soon, so as to include several developments of the software FindSources3D as well as a co-advised PhD.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Douglas Hardin (Vanderbilt University, Nashville, USA, Jun 2013)
- Matteo Oldoni (Siae Microelettronica, Milano, Italy, Nov 2013)
- Vladimir Peller (Michigan University, East Lansing, from May until Jun 2013)
- Yannick Privat (CNRS, Univ. P. et M. Curie, Paris, Dec 2013).
- Tao Qian (University of Macau, Taipa, China, Jul 2013)
- Edward Saff (Vanderbilt University, Nashville, USA, from May until Jun 2013)
- Michael Stessin (New York state University at Albany, USA, Jun 2013)
- Nikos Stylianopoulos (Univ. of Cyprus).
- Ian Sloan (University of New South Wales, Sydney, Australia, Jun. 2013).
- Maxim Yattselev (Indiana University–Purdue University, Indianapolis, USA, Mar 2013)

8.4.1.1. Internships

- K. Bashtova, Master 2 Mathmods - UNSA (6 months), Inverse source problems for electromagnetic fields, with physical applications.

8.5. List of international and industrial partners

- Collaboration under contract with Thales Alenia Space (Toulouse, Cannes, and Paris), CNES (Toulouse), XLIM (Limoges), University of Bilbao (Universidad del País Vasco / Euskal Herriko Unibertsitatea, Spain).
- Regular contacts with research groups at UST (Villeneuve d'Ascq), Universities of Bordeaux-I (Talence), Orléans (MAPMO), Aix-Marseille (CMI-LATP), Nice Sophia Antipolis (Lab. JAD), Grenoble (IJF and LJK), Paris 6 (P. et M. Curie, Lab. JLL), Paris Diderot (LAREG-IGN), CWI (the Netherlands), MIT (Boston, USA), Vanderbilt University (Nashville USA), Steklov Institute (Moscow), Michigan State University (East-Lansing, USA), Texas A&M University (College Station USA), State University of New-York (Albany, USA), University of Oregon (Eugene, USA), Politecnico di Milano (Milan, Italy), University of Trieste (Italy), RMC (Kingston, Canada), University of Leeds (UK), of Maastricht (The Netherlands), of Cork (Ireland), Vrije Universiteit Brussel (Belgium), TU-Wien (Austria), TFH-Berlin (Germany), ENIT (Tunis), KTH (Stockholm), University of Cyprus (Nicosia, Cyprus), University of Macau (Macau, China), BESA company (Munich), SIAE Microelettronica (Milano).
- The project is involved in the GDR-project AFHP (CNRS), in the ANR (Astrid program) project COCORAM (with XLIM, Limoges, and DGA), in a EMS21-RTG NSF program (with MIT, Boston, and Vanderbilt University, Nashville, USA), in the Associate Inria Team IMPINGE (with MIT, Boston), and in a CSF program (with University of Cyprus).

⁴<http://www.besa.de/>

BIPOP Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- CHASLIM Chattering Free Sliding Mode Control: ANR BLAN 2011 BS03 007 01 (octobre 2011–octobre 2015), coordinator B. Brogliato.

8.2. International Research Visitors

- Valentina Sessa from the University of Benevento, Italy, DIS, a six-month internship as a PhD student under the supervision of V. Acary and B. Brogliato,.

8.2.1. Visits of International Scientists

Visit of Prof. Yury Starovetsky from Technion, Israel, four weeks in 2013.

COMMANDS Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. DGA

Participants: Olivier Bokanowski, Anna Désilles, Hasnaa Zidani.

This project is a collaboration in the framework of a 3-year (2012-2015) research program funded by DGA. The title of the project is “Problèmes de commande optimale pour des systèmes non-linéaires en présence d’incertitudes et sous contraintes de probabilité de succès”.

7.1.2. ANR HJNet

Participants: Olivier Bokanowski, Zhiping Rao, Hasnaa Zidani.

The team is part of the collaborative project HJNet funded by the French National Research Agency (ANR-12-BS01-0008-01). It started in January 2013 and will end in December 2013. Website: <http://hjnet.math.cnrs.fr>

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. SADCO

Instrument: Initial Training Network

Duration: January 2011 - December 2014

Coordinator: Inria

Partner: Univ. of Louvain, Univ. Bayreuth, Univ. Porto, Univ. Rome - La Sapienza, ICL, Astrium-Eads, Astos solutions, Volkswagen, Univ. Padova, Univ. Pierre et Marie Curie.

Inria contact: Hasnaa Zidani

Abstract: Optimisation-based control systems concern the determination of control strategies for complex, dynamic systems, to optimise some measures of best performance. It has the potential for application to a wide range of fields, including aerospace, chemical processing, power systems control, transportation systems and resource economics. It is of special relevance today, because optimization provides a natural framework for determining control strategies, which are energy efficient and respect environmental constraints. The multi-partner initial training network SADCO aims at: Training young researchers and future scientific leaders in the field of control theory with emphasis on two major themes sensitivity of optimal strategies to changes in the optimal control problem specification, and deterministic controller design; Advancing the theory and developing new numerical methods; Conveying fundamental scientific contributions within European industrial sectors.

See: <http://itn-sadco.inria.fr>

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. OCONET

Title: Optimization and control in network economics

Inria principal investigator: Frédéric Bonnans

International Partner (Institution - Laboratory - Researcher):

University of Chile (Chile) - Center for Mathematical Modeling - Joseph Frédéric Bonnans

Duration: 2012 - 2014

See also: http://www.cmm.uchile.cl/EA_OCONET

Limited resources in telecommunication, energy, gas and water supply networks, lead to multi-agent interactions that can be seen as games or economic equilibrium involving stochastic optimization and optimal control problems. Interaction occurs within a network, where decisions on what to produce, consume, trade or plan, are subject to constraints imposed by node and link capacities, risk, and uncertainty, e.g. the capacity of generators and transmission lines; capacity of pipeline in gas supply; switches and antennas in telecommunication. At the same time, nonlinear phenomena arise from price formation as a consequence of demand-supply equilibria or multi-unit auction processes in the case of energy and telecommunication. We will focus first in this project in electricity markets in which there are producers/consumers PCs, and an agent called ISO (Independent system operator) in charge of the management of the network. One major application we have in mind is the one of smart (electrical) grids, in view of the increased use of renewable energies, that is, a massive entry of wind, geothermal, solar in particular.

7.3.2. Inria International Labs

- The team is involved in the "Energy Optimization" group of the Inria research center in Chile (CIRIC). Several visits to Chile were conducted in relation with this project.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- Prof. B.S. Goh, Curtin University, Miri, Malaysia; two weeks in February.
- M.S. Aronna, Rosario University, Argentina; one month (February and November).

7.4.1.1. Internships

- Arthur Marly, second year student of ENS Lyon. Two months internship. Subject: optimal control of populations with state constraints. Supervisor: F. Bonnans.

CORIDA Project-Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

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

6.2. National Initiatives

6.2.1. ANR

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

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

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

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

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

6.3. International Initiatives

6.3.1. Inria International Partners

6.3.1.1. Informal International Partners

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

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

6.4. International Research Visitors

6.4.1. Visits of International Scientists

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

Ademir Fernando Pazoto visited our team during March 2013.

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

6.4.2. Visits to International Teams

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

DISCO Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- DIGITEO Project (DIM LSC) ALMA
 Project title: Mathematical Analysis of Acute Myeloid Leukemia
 Decembre 2010 - December 2013
 Coordinator: Catherine Bonnet
 Other partners: Inria Paris-Rocquencourt, France, L2S, France, INSERM, Cordeliers Research Center, France.
 Abstract: this project studies a model of leukaemia based on previous works by M. Adimy and F. Crauste (Lyon), with theoretical model design adjustments and analysis in J. L. Avila Alonso's Ph D thesis and experimental parameter identification initiated by F. Merhi, postdoc of Bang (Dec. 2010-Nov. 2011), working at St. Antoine Hospital (Paris) on biological experiments on leukaemic cells.
- DIGITEO Project (DIM Cancéropôle) ALMA2
 Project title: Mathematical Analysis of Acute Myeloid Leukemia - 2
 October 2011 - March 2013
 Coordinator: Jean Clairambault (Inria Paris-Rocquencourt)
 Other partners: Inria Saclay-Île-de-France, France, L2S, France, INSERM, Cordeliers Research Center, France.
 Abstract: This project has taken over the experimental identification part in St. Antoine Hospital, together with further model design with the postdoc of A. Ballesta (BANG). With this postdoc project have also been developed the theoretical and experimental - in leukaemic cell cultures - study of combined therapies by classical cytotoxics (anthracyclins, aracytin) and recently available targeted therapies (anti-Flt-3).
- DIGITEO Project (DIM LSC) MOISYR
 Project title: Monotonie, observateur par intervalles et systèmes à retard.
 Decembre 2011- December 2014
 Coordinator: Frédéric Mazenc
 Other partners: L2S, France, Mines-ParisTech, France
 Abstract: MOISYR is concerned with the problem of extending the theory of monotone systems to the main families of continuous time systems with delay along with the application of this theory to the design of observers and interval observers. In particular, nonlinear systems with pointwise and distributed delays and stabilizable systems with delay in the input shall be considered. In a second step, we extend our result to discrete time systems and to a specific class of continuous/discrete systems called Networked Control Systems.

8.2. National Initiatives

8.2.1. ANR

An ANR Blanc SIMI 3 “Multidimensional Systems: Digression On Stabilities” (MSDOS) was submitted in 2013 and accepted. It will start in 2014 for a period of 4 years. Alban Quadrat is the local leader for Inria Saclay. For more details, see <http://www.lias-lab.fr/perso/nimayeganefer/doku.php>. Its main goal is to constructively study stabilities and stabilization problems of (nonlinear) multidimensional systems.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: GDRI (European research network founded by CNRS)

Project acronym: DelSys

Project title: Delay Systems

Duration: 2011-2015

Coordinator: Silviu Iulian Niculescu

Other partners: GIPSA-Lab and LAAS France, Ancona University Italy, Czech Technical University in Prague Czech Republic, Kent University Great-Britain, KTH Stockholm Sweden and KU Leuven Belgium.

Abstract: the aim of this GDRI is to bring together the main European teams which work in the fields of Delay systems. This network meets once a year.

Program: PHC Aurora (Norway)

Project acronym: 28920SB

Project title: Connections between constrained control law synthesis and theory of positive dynamical systems

Duration: 2013

Coordinator: Sorin Olaru (French leader), Morten Hovd (Norwegian leader)

Other partners: NTNU Trondheim

Abstract: The project is constructed with two main scientific objectives: a) The (controlled) invariant set computation and their use in the stability analysis The main objective is the construction of invariant sets of reduced complexity in terms of generators (for example vertices in polyhedral/zonotopic sets). Such invariant sets are related to the positivity by the invariance of the positive orthant of a dual (comparison) state space. The existence of invariant sets will be subsequently linked through this comparison systems with the stability analysis of complex (large scale, interconnected, hybrid, delay-affected or nonlinear) dynamics. The results will be compared with the state of the art methods as for example those related to the feasible set description in Model Predictive Control related problems. b) Control design for constrained dynamical systems Once the invariance tools with manageable complexity are available, the respective set will be employed in the synthesis procedure as Lyapunov level sets. Practically this will lead to polyhedral Lyapunov functions type of constructions for which interpolation based techniques have recently been shown to be effective. Further, the robustness and the performance of the resulting closed-loop dynamics need to be adjusted in accordance with the choice of the interpolation factor. These control design degrees of freedom need to be adjusted with respect to positiveness or monotonicity requirements.

Program: PHC Pessoa (Portugal)

Project acronym: 28750QA

Project title: Robust Distributed Model Predictive Control of Medium- and Large- Scale Systems

Duration: 2013-2014

Coordinator: Cristina Stoica (French leader), Fernando Lobo Perreira (Portuguese leader)

Other partners: Sorin Olaru

Program: PHC Brancusi (Romania)

Project acronym: 28705PF

Project title: Adaptive and predictive control of bioprocesses (modelling, identification and control of interconnected bioprocesses)

Duration: 2013-2014

Coordinator: Sihem Tebbani (French leader), Dan Selisteanu (Romanian leader)

Other partners: Sorin Olaru

Program: PHC Parrot

Project acronym: CASCAC

Project title: Computer Algebra, Symbolic Computation, and Automatic Control

Duration: 2013 - 2014

Coordinator: Alban Quadrat (French leader), Maris Tõnso (Estonian leader)

Other partners: Institute of Cybernetics, University of Tallinn

Abstract: The CASCAC project is at the interfaces of control theory, computer algebra and software engineering. The goals of the project are: 1. Develop new theoretical results on nonlinear control systems defined by functional equations (e.g., ordinary differential equations, partial differential equations, differential time-delay equations, partial difference equations). 2. Implement them on dedicated softwares developed in the computer algebra system Mathematica. In particular, Mathematica versions of the OREMODULES and ORE MORPHISMS packages will be developed. 3. Develop an interface between the C library BLAD (<http://www.lifl.fr/~boulrier/pmwiki/pmwiki.php?n=Main.BLAD>) – dedicated to differential algebra techniques – and Mathematica. This interface will allow one to have access to differential elimination techniques in Mathematica and to use them in decision methods for nonlinear control theory. 4. Co-supervise the Master thesis of Kristina Halturina with Prof. Ülle Kotta on constructive aspects of differential flatness and its applications to control theory (e.g., tracking, motion planning).

Program: PHC Rila (Bulgaria)

Project acronym: 29401YJ

Project title: Robust Distributed Model Predictive Control of Medium- and Large- Scale Systems

Duration: 2013-2014

Coordinator: Sorin Olaru (French leader), Alexandra Grancharova (Bulgarian leader)

Other partners: Bulgarian Academy of Science

Abstract: The project intends to address the control design of large scale dynamical systems with an emphasis on distributed predictive control strategies. There are two points of view with respect to the control synthesis in this framework: a. avoid the use of a global prediction model in the receding horizon optimal control of the subsystems and privilege the use of a coordination level in the decision process; b. consider the distributed synthesis for a network of discrete-time constrained linear systems without central coordinator. In the present project we intend to contribute to both of these directions by: a. Prediction of the interactions in between subsystems in a decomposition-coordination scheme. This can be done by imposing a reduced set of constraints for the MPC problems at the lower levels. b. With respect to the MPC design in the absence of coordination one of the issues will be the definition of appropriate terminal sets, ensuring invariance properties or at least recursive feasibility for the global functioning. We will investigate the construction of terminal set for a stabilizing centralized MPC decomposable in the form of a cross product of sets in each subsystem state space. An interesting idea on this direction was presented recently by the participants in this project.

8.3.2. Collaborations with Major European Organizations

Partner 1: University of l'Aquila, Italy

Nonlinear delay systems interconnected with a differential-difference equation.

Partner 2: RWTH Aachen University, Germany

Mathematical systems theory, control theory, symbolic computation

Partner 3: Bilkent University, Turkey

Control of linear and nonlinear systems with delays, medical applications

Partner 4: Tel Aviv University, Israel

Stability analysis of nonlinear Partial Differential Equations

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal International Partners

- UNICAMP, Sao Paulo, Brazil
- Kyushu Institute of Technology, Iizuka, Fukuoka, Japan
- Louisiana State University, Baton Rouge, USA
- University of California, San Diego, CA, USA

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Within the PHC Parrot (Inria Saclay - Institute of Cybernetics, University of Tallinn), Ülle Kotta, Maris Tõnso and Juri Belikov visited the DISCO project (twice for a week).

Within the invited Professor Program of DIGITEO, Prof. Georges BiTSORIS visited the DISCO project and Supélec from January-July 2013 and Emilia Fridman visited the DISCO project in September 2013.

8.5.2. Visits to International Teams

Alban Quadrat was invited by the Mathematics department of the Universidad Nacional de Colombia Bogotá (Colombia) for two weeks, and at the Tempere University of Technology (Finland).

GECO Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

- **Digitéo project CONGEO.** CONGEO (2009–2013) is financed by Digitéo in the framework of the DIM *Logiciels et systèmes complexes*. It focuses on the neurophysiology applications. U. Boscain, Y. Chitour (leader), F. Jean and P. Mason are part of the project.
- **Digitéo project 2012-061D SSyCoDyC.** SSyCoDyC (2013–2014) is financed by Digitéo in the framework of the DIM *Hybrid Systems and Sensing Systems*. It focuses on the application of techniques of hybrid systems to the analysis of retarded equations with time-varying delays. SSyCoDyC finances the post-doc fellowship of Ihab Haidar and is coordinated by Paolo Mason and Mario Sigalotti.

7.2. National Initiatives

- **ANR project GCM.** The project ANR GCM (*programme blanc*, 2009–13) involves the great majority of GECO's members (permanent and external). It focuses on various theoretical aspects of geometric control and on quantum control. It is coordinated by J.-P. Gauthier.

7.3. European Initiatives

7.3.1. FP7 Projects

Program: ERC Starting Grant

Project acronym: GeCoMethods

Project title: Geometric Control Methods for the Heat and Schroedinger Equations

Duration: 1/5/2010 - 1/5/2015

Coordinator: Ugo Boscain

Abstract: The aim of this project is to study certain PDEs for which geometric control techniques open new horizons. More precisely we plan to exploit the relation between the sub-Riemannian distance and the properties of the kernel of the corresponding hypoelliptic heat equation and to study controllability properties of the Schroedinger equation.

All subjects studied in this project are applications-driven: the problem of controllability of the Schroedinger equation has direct applications in Laser spectroscopy and in Nuclear Magnetic Resonance; the problem of nonisotropic diffusion has applications in cognitive neuroscience (in particular for models of human vision).

Participants. Main collaborator: Mario Sigalotti. Other members of the team: Andrei Agrachev, Riccardo Adami, Thomas Chambrion, Grégoire Charlot, Yacine Chitour, Jean-Paul Gauthier, Frédéric Jean.

7.4. International Initiatives

7.4.1. Inria International Partners

7.4.1.1. Informal International Partners

SISSA (Scuola Internazionale Superiore di Studi Avanzati), Trieste, Italy.

Sector of Functional Analysis and Applications, Geometric Control group. Coordinator: Andrei A. Agrachev.

We collaborate with the Geometric Control group at SISSA mainly on subjects related with sub-Riemannian geometry. Thanks partly to our collaboration, SISSA has established an official research partnership with École Polytechnique.

7.4.2. Participation In other International Programs

- Laboratoire Euro Maghrébin de Mathématiques et de leurs Interactions (LEM2I)
<http://www.lem2i.cnrs.fr/>
- GDRE Control of Partial Differential Equations (CONEDP)
<http://www.ceremade.dauphine.fr/~glass/GDRE/>

I4S Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. Collaboration with ADVITAM

Participants: Laurent Mevel, Dominique Siegert, Ivan Gueguen.

contract 6841.

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

7.1.2. Collaboration with STX

Participants: Dominique Siegert, Ivan Gueguen.

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

7.1.3. Collaboration with ISAE

Participants: Laurent Mevel, Ahmed Jhinaoui.

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

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. FP7 ISMS

Participants: Laurent Mevel, Michael Doehler.

Type: PEOPLE

Instrument: Industry-Academia Partnerships and Pathway (IAPP)

Duration: September 2010 - August 2014

Coordinator: SVS (Structural Vibrations Solutions) (Denmark)

Others partners: University of British Columbia, Canada

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

7.2.1.2. MODRIO Project

Participant: Qinghua Zhang.

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

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

7.3. International Initiatives

7.3.1. Inria International Partners

7.3.1.1. SIMS, Canada

Participants: Michael Doehler, Laurent Mevel.

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

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

7.3.1.2. Collaboration on damage localization and monitoring with Boston University

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

7.3.2. Participation In International Programs

7.3.2.1. Northeastern University

Participants: Laurent Mevel, Michael Doehler, Luciano Gallegos.

Program: International joint supervision of PhD agreement

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

Inria principal investigator: Laurent MEVEL

Northeastern University (United States)

Duration: May 2011 - Apr 2014

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

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Participants: Koen Tiels, Palle Andersen.

Palle Andersen was here for 3 months within ISMS project.

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

Maxplus Project-Team

8. Partnerships and Cooperations

8.1. Actions nationales/National Initiatives

8.1.1. ANR

- Projet ANR Arpège ASOPT (Analyse statique et Optimisation), responsable B. Jeannot. Partenaires: équipe-projet Popart (Inria Grenoble), équipe MeASI, EADS, et Maxplus. Ce projet a été labellisé par le pôle de compétitivité System@tic.
- Participation de Cormac Walsh au projet ANR FINSLER (Géométrie de Finsler et applications).
- Projet ANR CAFEIN (Combinaison d'approches formelles pour l'étude d'invariants numériques), responsable P.L. Garoche. Partenaires: ONERA, CEA LIST, ENSTA Paristech, Inria Saclay (Maxplus, Toccata, Parkas), Université de Perpignan, Prover, Rockwell Collins France.

8.1.2. Programme Gaspard Monge pour l'Optimisation

Projet intitulé "Méthodes tropicales pour l'optimisation", responsable X. Allamigeon, faisant intervenir M. Akian, P. Benchimol, S. Gaubert, R. Katz, et Z. Qu.

8.2. Actions internationales/International Initiatives

8.2.1. Inria International Partners

8.2.1.1. Informal International Partners

Collaborations régulières dans le cadre des programmes internationaux ci-dessous, ainsi qu'avec:

- Ricardo Katz (Conicet et Cifasis, Argentine);
- Alexander Guterman (Moscow State University);
- Françoise Tisseur (Université de Manchester) qui participe à l'encadrement de la thèse d'Andrea Marchesini.

8.2.2. Participation In other International Programs

- La thèse de Pascal Benchimol est financée par une bourse Monge/DGA prévoyant des visites régulières du doctorant dans l'équipe de Michael Joswig (TU-Darmstadt).
- La thèse de Zheng Qu est co-encadrée par Shanjian Tang de l'Université Fudan (Shanghai), dans l'équipe duquel la doctorante effectue une partie de son travail de recherche.
- Les membres de l'équipe sont partenaires du Grant RFBR–CNRF 11-01-93106 "Tropical Mathematics and Mathematical Physics", porté par l'équipe de Grigori Litvinov (Moscou independent University).

8.3. Accueils de chercheurs étrangers/International Research Visitors

8.3.1. Chercheurs étrangers/Visits of International Scientists

- Zur Izhakian, 2 jours en Février.
- Srinivas Sridharan (University of California San Diego), 1 semaine en Mai.
- Ricardo Katz (Conicet, Rosario, Argentine), 2 mois en mars-avril, financé par PGMO.
- Alexander Guterman (Université d'état de Moscou), 5 jours en Septembre.
- Françoise Tisseur (Univ. Manchester), 4 jours en Janvier.

- James Hook (Univ. Manchester), 4 jours en Janvier et 4 jours en Octobre.
- Visite d'un jour de Maurizio Falcone (autour de la thèse de Zheng Qu).
- Visites d'un jour d'Yves Bertot, Didier Henrion, Monique Laurent, Markus Schweighofer, et de 4 jours de Thomas Hales (autour de la thèse de Victor Magron).

8.3.2. Séjours à l'étranger/Visits to International Teams

- P. Benchimol, visite à TU Darmstadt, décembre 2013 (1 semaine).
- A. Marchesini, séjour à l'Université de Manchester, avril 2013 (5 jours).
- M. Akian, séjour à l'Université de Manchester, avril 2013 (2 jours).
- X. Allamigeon, visite à TU Berlin, décembre 2013 (2 jours).

MCTAO Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

The “région” *Provence Alpes Côte d’Azur* (PACA) partially supports Helen Heninger’s PhD . The other part comes from Thales Alenia space, see section 7.1 .

The “région” *Provence Alpes Côte d’Azur* (PACA) partially supports Jérémy Rouot’s PhD.

8.2. National Initiatives

8.2.1. IMB - Université de Bourgogne, Dijon

The team is officially a common team with University of Nice, but also has very strong links with Université de Bourgogne and IMB (Institute of Mathematics in Burgundy). Bernard Bonnard is currently on leave from Université de Bourgogne; Jean-Baptiste Caillau collaborates actively with us; there is also an active common seminar http://math.unice.fr/~rifford/publis/Journee_McTAO/J_McTAO.html .

A formal convention between Inria and Université de Bourgogne is planned for 2014. It will make the IMB control team a part of McTAO.

8.2.2. GCM (ANR project)

This is a four year project ending in 2013, on Geometric Control Methods, Sub-Riemannian Geometry and Applications. It is organized in four “poles” and gathers people from Université du Sud Toulon-Var, Université de Bourgogne (Dijon), École Polytechnique (Paris), Nancy-Université, Université Joseph Fourier (Grenoble 1), Université Paris Sud, ParisTech ENSTA and Université Nice Sophia-Antipolis. Bernard Bonnard, Jean-Baptiste Caillau and Ludovic Rifford (leader of one pole) are members of this project. More details on the site; <http://www-fourier.ujf-grenoble.fr/~charlot/GCM.html>.

8.2.3. Others

Bernard Bonnard and Ludovic Rifford participate in the GDR MOA, a CNRS network on Mathematics of Optimization and Applications. <http://gdrmoa.univ-perp.fr/>.

Jean-Baptiste Caillau is in the board of governors of the group SMAI-MODE (<http://smai.emath.fr/spip.php?article338>).

Jean-Baptiste Caillau is a member of the Centre de Compétences Techniques (CCT) Mécanique orbitale du CNES

Jean-Baptiste Caillau is the corresponding member in Dijon for the Labex AMIES (<http://www.agence-maths-entreprises.fr/>).

8.3. European Initiatives

8.3.1. FP7 Projects

Jean-Baptiste Caillau is a member of the SADCO network (FP7-PEOPLE-2010-ITN, grant no. 264735-SADCO), cf. <http://itn-sadco.inria.fr>.

8.3.2. Collaborations with Major European Organizations

Technische Universität München, Department of Chemistry (Germany).

The applications of optimal control to MNR (see sections 4.2) are conducted with the group of Prof. Steffen Glaser in Munich.

8.4. International Initiatives

University of Hawaii, Department of Mathematics (U. S. A.)

There is a long term collaboration on optimal control and control of quantum systems, see mostly section 6.1.1. Besides, Gautier Picot, a former Phd student from Dijon has a temporary position at the Math Department and collaborates with M. Chyba and G. Patterson (second Phd student from M. Chyba) in relation with the Laboratoire d'Astronomie de Paris, to apply the Hampath code to make rendez-vous with quasi-asteroids entering in the solar system near the L1-Lagrange point, in the continuation of the work developed by G. Picot and B. Daoud. This collaboration is very active and has to be emphasized.

University of Toronto, Department of Mathematics (Canada)

Optimal Transport. Alice Erlinger's PhD is co-supervised by Ludovic Rifford and John Mc Cann from University of Toronto. See section 6.4.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Alessio Figalli, from University of Texas at Austin, visited twice, for a total of slightly more than a month.

8.5.2. Visits to International Teams

There is a strong collaboration with the control group in the University of Hawaii around M. Chyba. B. Bonnard visited the group twice in 2012-2013 (a total of 3 months). The purpose of the collaboration is to study the aspects of the contrast problem in Nuclear Magnetic Resonance, see section 6.1.1.

Ludovic Rifford was invited to the program "Optimal Transport: Geometry and Dynamics" (<http://www.msri.org/programs/277>) from august to December at MSRI, Berkeley, USA.

Bernard Bonnard was invited to the Japanese forum "Math-for-Industry" 2013 on *The Impact of Applications on Mathematics*, November 4 to 8, 2013, Fukuoka. See <http://fmi2013.imi.kyushu-u.ac.jp/>.

NECS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR VOLHAND

VOLHAND (**VO**Lant pour personne âgée et/ou **HAN**Dicapée) is a project funded by the ANR (National Research agency). This project, started in October 2009, is a result of collaboration between C. Canudas de Wit and Franck Quaine/Violaine Cahouët (from the biomechanical team of GIPSA-LAB). The project has concerned the development of a new generation of Electrical power-assisted steering specifically designed for disabled and aged people. Our contribution has been to design new assisted laws, taking into account the specific mechanical characteristics of this particular population of drivers. The consortium was composed by: LAMIH, CHRU, Fondation Hopale, GIPSA-LAB, INRETS and JTEKT. More information can be found on-line: <http://www.univ-valenciennes.fr/volhand/>.

8.1.2. PREDIT MoCoPo

The MOCOPo project (Measuring and mOdelling traffic COngestion and POLLution) is funded by the French Ministry in charge of Transport (MEDDTL), through the PREDIT (Research and Innovation in Land Transport Program). The project began in January 2011 and will end up in December 2013. Various research institutes and universities, some teams of the MEDDTL and pollution measurements associations are involved in the project: LICIT (Transport and Traffic Engineering Laboratory, joint unit of IFSTTAR and ENTPE), LTE (Transports and Environment Laboratory, IFSTTAR), LEPSIS (Laboratory for Road Operations, Perception, Simulators and Simulations, IFSTTAR), IM (Infrastructures and Mobility Department, IFSTTAR), MACS (Monitoring, Assessment, Computational Sciences, IFSTTAR), Inria-NECS, Atmo Rhône Alpes, DIR-CE (Center-East Direction of Roads), LRPC Angers (Regional Laboratory of Angers), CERTU (Center for Cities and Urban Transportation), and CEREAs (Center of Teaching and Research in Atmospheric Environment, laboratory Ecole des Ponts ParisTech / EDF Research and Development). NECS is particularly involved in tasks devoted to travel-time estimation and prediction. For this purpose one post-doc (Fabio Morbidi) has been hired. More information can be found on-line: <http://mocopo.ifsttar.fr/>.

8.1.3. PEPS META-TRAM

META-TRAM is a PEPS-CNRS project funded for two years (2013-2015). It aims at studying tensor methods for analyzing traffic data. Indeed, for a better management of mobility in modern cities (avoid or better control episodes of congestion, accurately predict traffic trends, finely analyze urban and suburban trips via multimodal networks), it is necessary to develop appropriate analytic tools that integrate multimodality and heterogeneity of networks from inherently multidimensional measures. Three areas are studied: tensor modeling for estimating origin-destination matrices, dynamic clustering flow and synthesis of distributed algorithms adapted to large volume of data, diversity of sensors, and their spatial dispersion. This project involves also I3S Lab (Sophia Antipolis) and CRAN (Nancy).

8.1.4. Other collaborations

Inertial and magnetic data integration for human movements analysis

The goal of this consortium is to work together on how to deal with inertial data in different or complementary fields. Orange Grenoble lab works on the analysis of inertial data. Orange sells some smart-phones equipped with inertial unit. The goal of Orange is to develop from these data some analysis bricks. The bricks are identified by: a) Monitoring of activity by identifying postures and deduce the activity by a correlation table, b) Prevention of falls by an analysis of walking monitoring, c) Monitoring of indoor and outdoor trajectory, d) Position of the sensor, and e) Identification of the dynamic parts of the signal. Orange offers to provide laboratories participating in the consortium: a) The database created through a 2012 IGS experiment where 7 peoples wore smart-phones for 3 months and the report of the experiment, b) The ability to store the data recorded by the consortium on a server in the capacity limit of the predefined server, c) The loan of smart-phones, and d) A schedule of specifications of a service activity monitoring of remote person. A consortium agreement has been signed by eight laboratories: INSA-INL, UJF-AGIM, UJF-GIPSA, CNRS-LAAS, CNRS-IRIT, Amines- école des mines de Douai, ISFTTAR, UTT et Orange Labs.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. Hycon2

Type: COOPERATION

Objective: Engineering of Networked Monitoring and Control Systems

Instrument: Network of Excellence

Objective: Engineering of Networked Monitoring and Control systems

Duration: September 2010 - August 2014

Coordinator: CNRS (France)

Partners: Inria (France), ETH Zurich (Switzerland), TU Berlin (Germany), TU Delft (Netherlands) and many others

Inria contact: C. Canudas de Wit

Abstract: Hycon 2 aims at stimulating and establishing a long-term integration in the strategic field of control of complex, large-scale, and networked dynamical systems. It focuses in particular on the domains of ground and aerospace transportation, electrical power networks, process industries, and biological and medical systems.

See also: <http://www.hycon2.eu>

8.2.1.2. SPEEDD (Scalable Proactive Event-Driven Decision making)

Type: STREP

Objective: ICT-2013.4.2a – Scalable data analytics – Scalable Algorithms, software frameworks and viualisation

Duration: Feb. 2014 to Jan. 2017.

Coordinator: National Centre of Scientific Research ‘Demokritos’ (Greece)

Partners: IBM Israel, ETH Zurich (CH), Technion (Israel), Univ. of Birmingham (UK), NECS CNRS (France), FeedZai (Portugal)

Inria contact: C. Canudas de Wit

Abstract: SPEEDD will develop a prototype for robust forecasting and proactive event-driven decision-making, with on-the-fly processing of Big Data, and resilient to the inherent data uncertainties. NECS will lead the intelligent traffic-management use and show case.

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

8.2.1.3. CPSoS

Carlos Canudas de Wit participates to the working group WG1 “Systems of Systems in transportation and logistics” of the support action CPSoS “Towards a European Roadmap on Research and Innovation in Engineering and Management of Cyber-physical Systems of Systems”, led by TU Dortmund (Germany).

8.3. International Initiatives

8.3.1. Inria Associate Teams

NECS has submitted a proposal for the construction of a new associate team: COMFORT, with partner UC Berkeley/PATH. The proposal has been accepted, and the associate team will be funded for the period 2014-2016.

8.3.2. Inria International Partners

H. Fourati has a collaboration with the Kazakhstan National Technical University (KazNTU). He currently co-advises (with Pr. Olga Shiryayeva in KazNTU) Zarina Samigulina, a PhD student in KazNTU.

8.3.3. Participation In other International Programs

8.3.3.1. TeMP

TeMP (Tensor-based information Modelling and Processing) is a project funded in the framework of the French-Brazilian bilateral collaboration program (FUNCAP-Inria). It started from August 2011 and ended in December 2013. It was coordinated for the French part by A. Kibangou and aimed to study, analyze, propose and evaluate new models and techniques for digital communication systems using tensors and multilinear algebra tools, through in-depth theoretical analysis of mathematical models, optimization algorithms, and computational simulations. Distributed and collaborative algorithms have been devised for processing tensors involved in cooperative communications. In addition, new methods for processing very large tensors (big data issue) have been obtained. A special session has been organized in CAMSAP 2013 by A. de Almeida, the coordinator of the Brazilian side of the project.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Zarina Samigulina, PhD student, Kazakhstan National Technical University (KazNTU), one-month visit (mid-May to mid-July).
- The following professors from UFC Brazil visited NECS within the framework of the TeMP project: André L. F. de Almeida (Associate Professor) in February and November for one week each stay; Carlos Alexandre Rolim Fernandes (Associate Professor) in May for one week; Carlos Estevao Rolim Fernandes (Associate Professor) in May for three days.
- prof. Antonella Ferrara, from Università di Pavia (Italy), has been visiting NECS regularly, with multiple visit of a few days, for an active collaboration on the traffic application, within Hycon2 project.

8.4.1.1. Internships

- Giulio Bontadini, Master student, Università di Pavia (Italy), from March to August, co-advised by C. Canudas de Wit and A. Ferrara, master thesis: *Modeling and control of traffic systems*
- Yvan Gaudfrin, Master student, University of Bristol (UK), from June to September, co-advised by F. Garin, R. Fabbiano and J. Dumon, master thesis: *Source seeking via Poisson integrals – Practical implementation of a source-localization set-up.*

8.4.2. Visits to International Teams

- D. Pisarski has been a visiting scholar at UC Berkeley, Mechanical Engineering Dept., for three months (Oct.-Dec.). His stay was supported by Inria 'Programme Explorateur' and CMIRA 'Explora Doc'.
- A. Kibangou spent two weeks in UFC, Brazil, in October, within the framework of the TeMP project.

NON-A Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

- Project ARCIR «Estimation distribuée de systèmes dynamiques en réseaux», supervisor Prof. Mihaly Petreczky, URIA – Mines de Douai, 2013–2015
- CPER CIA, "Internet of Things", 2011–2015
- CPER CISIT, "Campus international sur la securite et intermodalite de transport", project "CONTRAERO" with LML and IEMN, 2011–2015
- ADT Inria SLIM "Development of ROS software library for multi-robots cooperation", 2013–2014
- Project Agrégation, Conseil Général du Val d'Oise, (<http://www.scilab.org/fr/community/scilabtec/2013/Projet-Agregation-la-simulation-numerique-dans-les-essais>)

7.2. National Initiatives

- CNRS GDRI DelSys (<http://www.cnrs.fr/ins2i/spip.php?article217>)
- CNRS-CONACYT project with Mexico, "Estimation of state for hybrid systems using sliding mode techniques", 2013
- ANR project ChaSlIM (Chattering-free Sliding Modes), coordinator Prof. B. Brogliato: 2012-2015
- We are also involved in several technical groups of the GDR MACS (CNRS, "Modélisation, Analyse de Conduite des Systèmes dynamiques", see <http://www.univ-valenciennes.fr/GDR-MACS>), in particular: Technical Groups "Identification", "Time Delay Systems", "Hybrid Systems" and "Control in Electrical Engineering".
- Model-free control: collaborations with Professor Brigitte D'Andréa-Novel at Mines ParisTech and Professor Emmanuel Delaleau at ENIB (Brest).
- Atomic Force Microscope (AFM): application of new algebraic methods in tapping mode for AFM, collaboration with the National Laboratory of Metrology (LNE) located at Trappes.

7.3. European Initiatives

7.3.1. FP7 Projects

- *HYCON2* (<http://www.hycon2.eu/>) The FP7 NoE HYCON2, started in September 2010, is a four-year project coordinated by the CNRS (Françoise Lamnabhi-Lagarrigue). It aims at stimulating and establishing a long-term integration in the strategic field of control of complex, large-scale, and networked dynamical systems. It focuses in particular on the domains of ground and aerospace transportation, electrical power networks, process industries, and biological and medical systems.
- *SYSIASS* (<http://www.sysiass.eu/>) Here is the major issue on which the project SYSIASS seeks to answer by developing new technologies and putting them in the service of patients and health professionals from our regions. Indeed preserve the autonomy of the elderly and disabled people is a major issue in today's society. In Europe, with the progressive ageing of the population policy to support the elderly is increasingly based on the assumption that care must be provided efficiently to the patient where he is based. In addition, special attention is devoted to people with disabilities for their better integration into society. Advances in technology proposed by SYSIASS (SYStème Intelligent et Autonome d'aide aux Soins de Santé / Autonomous and Intelligent Healthcare System) will be realized in practice through an intelligent wheelchair that can provide better mobility to the patient and to allow health care professionals to easily transport patients to desired locations within a clinic or home environment. Moreover such a system must be able to communicate with the outside world, to adapt to specific patient needs and any special disability that he may have, and to facilitate access to medical data for health professionals.

- *ICityForAll: EU Ambient Assisted Living Program* (<http://www.icityforall.eu/>) The project is led by CEA and it includes University of Paris Descartes-UPD, CENTICH, Active Audio (SME, France), Tech. Univ of Munich - TUM (Germany), EPFL (Suisse), ENEA (Italy), Centro Ricerche FIAT-CRF (Italy). The goal of I'City for All (Age sensitive ICT systems for Intelligible City for All) is to enhance speech and audio alarms intelligibility in order to improve the sense of well-being of seniors through better social interactions, better security and then improved mobility. Mamadou Mboup is involved as a subcontractor of UPD.

7.4. International Initiatives

7.4.1. Inria International Partners

7.4.1.1. Informal International Partners

- Professor Emilia Fridman, Tel Aviv University, Israel
- Sliding Mode Control Laboratory, UNAM, Mexico
- Department Control Automatico, CINVESTAV-IPN, Mexico
- Department of Control Systems and Informatics, Saint Petersburg State University of Information Technologies Mechanics and Optics (ITMO), Russia

7.4.2. Inria International Labs

Inria North European Labs 2013, "Dynamical precision improvement for industrial robots", project with Norwegian University of Science and Technology (Trondheim, Norway) and UMEA university (Sweden), 2013–2016

This collaborative project aims on development of algorithms used in software of industrial robots for estimation, regulation and trajectory planning in order to improve accuracy and repeatability of robots in the presence of varying parameters, perturbations and noises. A special attention is paid to the case when it is necessary to realize by robot effector a complex 3D movement with a good precision (3D surface profiling), where conventional calibration procedures fail to guarantee the required technical parameters.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

7.5.1.1. Internships

Lucas Langwagen

Subject: Numerical differentiation of noisy piecewise regular signal

Date: from Apr 2013 until Aug 2013

Institution: University of the Republic (Uruguay)

Leonid Fridman

Subject: State Observation and Parameter Identification in Hybrid Systems via High-Order Sliding-Modes

Date: June 2013 until July 2013

Institution: UNAM (Mexico)

Héctor Rios

Subject: State Observation and Parameter Identification in Hybrid Systems via High-Order Sliding-Modes

Date: June 2013 until July 2013

Institution: UNAM (Mexico)

Emmanuel Cruz

Subject: State Observation and Parameter Identification in Hybrid Systems via High-Order Sliding-Modes

Date: November 2013 until December 2013

Institution: UNAM (Mexico)

Tonametl Sanchez

Subject: State Observation and Parameter Identification in Hybrid Systems via High-Order Sliding-Modes

Date: November 2013 until December 2013

Institution: UNAM (Mexico)

Emilia Fridman

Subject: Time-delay and Hybrid Systems

Date: June 2013 until July 2013

Institution: Tel Aviv University (Israel)

7.5.2. Visits to International Teams

- G. Zheng, Zhejiang University, China, May 2013

CLASSIC Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

- ANR project in the blank program: Calibration (2012–2015; involves Vincent Rivoirard, who is the coordinator; see <https://sites.google.com/site/anrcalibration/home>)
- ANR project in the blank program: Banhdits (2010–2013; involves Vincent Rivoirard; see <https://sites.google.com/site/anrcalibration/home>)
- PEPS Bio-Maths (“Estimation de graphes de dépendance entre neurones thalamiques et cortico-thalamiques via des modèles de Hawkes multivariés; 2012–2013; involves Vincent Rivoirard)

7.2. International Initiatives

We have one formal international collaboration, with

- Karine Bertin, University of Valparaiso, Chile (International cooperation CONICYT project, Andes Foundation project);

and other informal ones:

- Luc Devroye, McGill University, Canada;
- David Mason, Delaware University, USA;
- Shie Mannor, Technion, Israel.

DOLPHIN Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- PPF (Bioinformatics): This national program within the University of Lille 1 deals with solving bioinformatics and computational biology problems using combinatorial optimization techniques, 2010-2013.
- PPF HPC (High performance computing), 2010-2013.
- CIA (Campus Intelligence Ambiante) project from CPER (Contrat Plan Etat Région): Transversal research action: “High performance computing”, 2010-2013.

8.2. National Initiatives

8.2.1. ANR

- ANR project Transports Terrestres Durable “RESPET - Gestion de réseaux de service porte-à-porte efficace pour le transport de marchandises”, in collaboration with LAAS (Toulouse), DHL, JASSP, LIA (Univ. Avignon) (2011-2014).
- ANR project Modèles Numériques “NumBBO - Analysis, Improvement and Evaluation of Numerical Blackbox Optimizers” (2012-2016) in collaboration with Inria Saclay, TAO team, Ecole des Mines de St. Etienne, CROCUS team, and TU Dortmund University, Germany (2012-2016).

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: COST

Project acronym: IC0804

Project title: Energy efficiency in large scale distributed systems

Duration: Jan 2009 - May 2013

Coordinator: J. M. Pierson

Other partners: More than 20 European countries.

Abstract: The COST Action IC0804 proposes realistic energy-efficient alternate solutions to share IT distributed resources. As large scale distributed systems gather and share more and more computing nodes and Storage resources, their energy consumption is exponentially increasing. While much effort is nowadays put into hardware specific solutions to lower energy consumptions, the need for a complementary approach is necessary at the distributed system level, i.e. middleware, network and applications. The Action characterizes the energy consumption and energy efficiencies of distributed applications.

8.3.2. Collaborations with Major European Organizations

University of Luxembourg: CSC, ILIAS (Luxembourg)

Design of parallel and hybrid metaheuristics to solve complex optimization problems

University of Malaga: ETSI Informatica (Spain)

Parallel metaheuristics for dynamic optimization

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. STEM

Title: deciSion Tools for Energy Management (STEM)

Inria principal investigator: L. Brotcorne

International Partners (Institution - Laboratory - Researcher):

Polytechnic School of Montréal (Canada) - Département de mathématique et génie industriel

Université de Montréal (Canada) - Département d'informatique et recherche opérationnelle

Duration: 2012 - 2014

See also: <http://dolphin.lille.inria.fr/Dolphin/EA-DOLPHIN>

The economic rise of developing countries, together with the need to meet ever more stringent pollution reduction targets, will increase the stress on the global energy system. Within this framework, the goal of the current project is to develop decision tools for energy management in a context of market deregulation. We will focus on two issues, namely demand management and production planning.

The first problem is concerned with the efficient management of consumption. More precisely, the short or long term behaviour of customers can be influenced through signals sent by a utility (or several utilities) to the end-users. These signals can take the form of an "optimal" pricing scheme, or yet of devices (timers, automatic switches, etc.) designed to induce an "optimal" behaviour from the users.

The second issue is concerned with efficient management of sustainable energy production. Indeed the development of renewable energy introduces new parameters in the supply/demand global equilibrium process. The issue is to achieve the right trade-off between costs (production, security) and revenues when determining the daily hydro-electricity generation and storage within an environment where demand is stochastic.

The first problem is modeled as a bilevel program, the second one as a integer multi-objective stochastic program. Efficient and effective solution methods are developed and implemented to solve these problems.

8.4.2. Inria International Partners

- University of Sydney, Australia
- University of Montreal, Canada
- Ecole Polytechnique of Montreal, Canada

8.4.2.1. Declared Inria International Partners

- University of Luxembourg, Luxembourg

8.4.2.2. Informal International Partners

- University of Shinshu, Nagano, Japan: Evolutionary multi-objective optimization, landscape analysis, and search performance (JSPS project 2013-2016)
- Cooperation with Hernan Aguirre et Tanaka : Internship in Japan of A. Blot co-supervised by H. Aguirre, C. Dhaenens, L. Jourdan and Tanaka

8.4.3. Participation In other International Programs

- Inria STIC-Tunisie 2011-2013.
- CNRS PICS Luxembourg 2012-2014.

- Japanese Government Grant Program 2013.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Dr. Hernan Aguirre, Shinshu University, Japan
- Prof. Kiyoshi Tanaka, Shinshu University, Japan
- Prof. Michel Gendreau, University of Montreal
- Prof. Pascal Bouvry, University of Luxembourg

8.5.1.1. Internships

- Martin Drozdik [PhD student, Shinshu University, Japan, from Nov 2013]

8.5.2. Visits to International Teams

- E-G. Talbi, June 2013, Univ. Colchester, Sussex, UK
- E-G. Talbi, April 2013, Univ. Murcia, Spain

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 für 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 outgassing 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 Télédétection 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 conjunction 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.

MISTIS Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

- MISTIS is involved in three regional initiatives: PEPS (funded by CNRS and the PRES of Grenoble), AGIR (funded by Université Grenoble 1 and Grenoble-INP) and the MOTU project (funded by UPMF). The first two projects focus on the modelling of the extreme risk and its application in social science. The partners include the LTHE (Laboratoire d'étude des Transferts en Hydrologie et Environnement) and the 3S-R lab (Sols, Solides, Structures - Risques). The third project focuses on the use of statistical techniques for transportation data analysis and involves the GAEL laboratory (Grenoble Applied Economics Laboratory).
- MISTIS participates in the weekly statistical seminar of Grenoble. Jean-Baptiste Durand is in charge of the organization and several lecturers have been invited in this context.
- S. Girard is at the head of the probability and statistics department of the LJK since september 2012.

7.2. National Initiatives

7.2.1. Competitvity Clusters

MISTIS was a partner in a three-year MINALOGIC project (I-VP for Intuitive Vision Programming) supported by the French Government. The project was led by VI Technology (<http://www.vitechnology.com>), a world leader in Automated Optical Inspection (AOI) of a broad range of electronic components. The other partners involved were the CMM (Centre de Morphologie Mathématiques) in Fontainebleau, and Pige Electronique in Bourg-Les-Valence. The overall goal was to exploit statistical and image processing techniques more intensively to improve defect detection capability and programming time based on existing AOI principles so as to eventually reach a reliable defect detection with virtually zero programming skills and efforts. The final review of this project was held in March 2013 with live demos of our tools at VIT.

7.2.2. Inria project HEROES

The 2-year Inria ARC project AINSI (2011-12) coordinated by F. Forbes (<http://thalie.ujf-grenoble.fr/ainsi>) was followed with the same partners by a project entitled HEROES. HEROES stands for "HEmodynamics-infoRmed atlas of brain functiOnal and vascular territoriES from multimodal MR images". The goal, based on ASL and BOLD fMRI and advanced models, is to 1) provide individual brain maps of hemodynamic characteristics useful as biomarkers and 2) extend the use of functional MRI (BOLD or ASL) in the clinic through an improved characterization of the impact of vascular alterations under pathological conditions. The partners involved are Visages and Panama teams from Inria in Rennes and Parietal in Saclay, the INSERM Unit U594 (Grenoble Institute of Neuroscience) and CEA NeuroSpin.

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. HUMAVIPS

Title: Humanoids with audiovisual skills in populated spaces

Type: COOPERATION (ICT)

Defi: Cognitive Systems and Robotics

Instrument: Specific Targeted Research Project (STREP)

Duration: February 2010 - January 2013

Coordinator: Inria (France)

Others partners: CTU Prague (Czech Republic), University of Bielefeld (Germany), IDIAP (Switzerland), Aldebaran Robotics (France)

See also: <http://humavips.inrialpes.fr>

Abstract: Humanoids expected to collaborate with people should be able to interact with them in the most natural way. This involves significant perceptual and interactive skills, operating in a coordinated fashion. Consider a social gathering scenario where a humanoid is expected to possess certain social skills. It should be able to analyze a populated space, to localize people, and to determine whether they are looking at the robot and are speaking to it. Humans appear to solve these tasks routinely by integrating the often complementary information provided by multi-sensory data processing, from 3D object positioning and sound-source localization to gesture recognition. Understanding the world from unrestricted sensorial data, recognizing people's intentions and behaving like them are extremely challenging problems. The objective of HUMAVIPS has been to endow humanoid robots with audiovisual (AV) abilities: exploration, recognition, and interaction, such that they exhibit adequate behavior when dealing with a group of people. Developed research and technological developments have emphasized the role played by multimodal perception within principled models of human-robot interaction and of humanoid behavior. An adequate architecture has implemented auditory and visual skills onto a fully programmable humanoid robot (the consumer robot NAO). A free and open-source software platform has been developed to foster dissemination and to ensure exploitation of the outcomes of HUMAVIPS beyond its lifetime.

7.4. International Initiatives

7.4.1. Inria International Partners

7.4.1.1. Informal International Partners

The main international collaborations that we are currently trying to develop are with:

- Emma Holian and John Hinde from National University of Ireland, Galway, Ireland.
- K. Qin and D. Wraith from RMIT and Centre for Epidemiology and Biostatistics University in Melbourne, Australia.
- E. Deme and S. Sylla from Saint Louis university and IRD in Saint Louis, Senegal.
- Alexandre Nazin and Russian Academy of Science in Moscow, Russia.
- Alexis Roche and University Hospital Lausanne/Siemens Healthcare, Advanced Clinical Imaging Technology group, Lausanne, Switzerland.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

- Alexander Nazin (Russian Academy of Sciences, Russia) has been an invited researcher in the MISTIS team to work with Stéphane Girard and Anatoli Ioudistki (Université Grenoble 1).
- El Hadji Deme (Université Gaston Berger, Sénégal) has been hosted by the MISTIS team for two months. His stay has been partially funded by the Ibni Oumar Mahamat Saleh price.

7.5.1.1. Internships

Jennifer Sloboda (Master, from May 2013 until Aug 2013)

Subject: Physiologically-inspired Bayesian analysis of BOLD and ASL fMRI data

Institution: University of Michigan, Ann Arbor (United States)

Aina Frau-Pascual (Master, from May 2013 until Aug 2013)

Subject: Hemodynamically informed parcellation of cerebral fMRI data

Institution: University Paris Sud

Pham Van Trung (Master, from Apr 2013 until Sep 2013)

Subject: Implémentation et paquetage d'un modèle statistique des valeurs extrêmes.

Institution: Hanoi, Vietnam.

Seydou-Nourou Sylla (PhD, from October 2013 to December 2013)

Subject: Classification for medical data

Institution: Université Gaston Berger (Sénégal)

MODAL Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- Christophe Biernacki: Industrial studies, Arcelor-Mittal (C. Théry)
- Sophie Dabo-Niang:
 - Festival NEXT avec la ROSE DES VENTS : programme Cartes et Cartel du spectacle vivant – stratégies et fréquentation du festival NEXT en Nord Pas de Calais et Belgique (Tournai).
 - SIRIC (Site de Recherche Intégrée en Cancérologie) ONCOLILLE
- Guillemette Marot:
 - Institut Pasteur Lille, Équipe Etudes Transcriptomiques et Génomiques Appliquées, D. Hot
 - Institut Pasteur Lille, Équipe Peste et Yersinia pestis, F. Sebbane
 - Institut de Biologie de Lille, Unité d’approches fonctionnelle et structurale des cancers, O. Pluquet
 - Université Lille 2, Plate-forme de génomique fonctionnelle et Structurale, M. Figeac
 - CHRU Lille, Centre de Biologie Pathologie, Laboratoire d’Hématologie, C. Preudhomme

8.2. National events

- Alain Celisse belongs to the Statistics for Systems Biology group (SSB) in Paris.
- Julien JACQUES organized the first French Summer School in Astrostatistics (Annecy, October 2013).
- Christophe Biernacki co-organized with Gilles Celeux, Gérard Govaert and Florent Langrogné the 4th one-day meeting on Mixmod on September 2013 (~ 50 participants).
- Guillemette Marot belongs to the StatOmique working group <http://vim-iip.jouy.inra.fr:8080/statomique/>

8.3. International Research Visitors

8.3.1. Visits of International Scientists

Mahlet Tadesse (University of Georgetown), Mohamed Ben Alaya (INRS, Québec), Aliou Diop (University of Gaston Berger, Senegal), Papa Ngom (University UCAD, Senegal).

8.3.1.1. Internships

Every year the Modal team welcomes numerous internships from various areas: Master 2 (Applied mathematics in Lille 1, Besançon,...), École centrale Lille, École PolytechLille, IUT A,...Some of them are awarded by a grant and then become PhD students (Jérémy Kellner, Quentin Grimonprez, Julie Hamon, Mathieu Marbac-Lourdelle,...).

8.3.2. Visits to International Teams

Julien Jacques was invited to the Working-Group on Model-Based Clustering of Adrian Raftery (Univ. Washington).

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 contribute 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 acceleration through stabilization techniques [59]. Jinil has pushed the column generation for extended formulation 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 this project 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.

SELECT Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

SELECT is animating a working group on model selection and statistical analysis of genomics data with the Biometrics group of AgroParisTech.

Pascal Massart is co-organizing a working group at ENS (Ulm) on Statistical Learning. This year the group focused interest on regularization methods in regression.

SELECT is animating a working group on Classification, Statistics and fMRI imaging with Neurospin.

8.2. European Initiatives

Gilles Celeux and Pascal Massart are members of the PASCAL (Pattern Analysis, Statistical Learning and Computational Learning) network.

8.3. International Initiatives

Gilles Celeux is one of the co-organizers of the Working Group on Model-Based Clustering. This year this workshop took place in Bologna (Italy).

SequeL Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR-Lampada

Participants: Mohammad Ghavamzadeh, Jérémie Mary, Olivier Nicol, Philippe Preux, Daniil Ryabko.

- *Title:* Learning Algorithms, Models and sPArse representations for structured DATA
- *Type:* National Research Agency (ANR-09-EMER-007)
- *Coordinator:* Inria Lille – Nord Europe (Mostrare)
- *Others partners:* Laboratoire d’Informatique Fondamentale de Marseille; Laboratoire Hubert Curien à Saint Etienne; Laboratoire d’Informatique de Paris 6.
- *Web site:* <http://lampada.gforge.inria.fr/>
- *Duration:* ends mid-2014
- *Abstract:* Lampada is a fundamental research project on machine learning and structured data. Lampada focuses on scaling learning algorithms to handle large sets of complex data. The main challenges are 1) high dimension learning problems, 2) large sets of data and 3) dynamics of data. We consider evolving data. The representation of these data involves both structure and content information and are typically large sequences, trees and graphs. The main application domains are web2, social networks and biological data.

The project proposes to study formal representations of such data together with incremental or sequential machine learning methods and similarity learning methods.

The representation research topic includes condensed data representation, sampling, prototype selection and representation of streams of data. Machine learning methods include edit distance learning, reinforcement learning and incremental methods, density estimation of structured data and learning on streams.

- *Activity Report:*

Philippe Preux has collaborated with Ludovic Denoyer and Gabriel Dulac-Arnold from LIP’6 to investigate further the idea of datum-wise representation, introduced in 2011.

Mohammad Ghavamzadeh and Philippe Preux have collaborated with Hachem Kadri on an operator-based approach for structured output [15].

Daniil Ryabko has developed a theory for unsupervised learning of time-series dependence, where the time series are either coming from a stationary environment or are a result of interaction with a Markovian environment with a continuous state space. Danil Ryabko and Jeremie Mary have developed methods for using binary classification methods for solving various unsupervised learning problems about time series.

8.1.2. ANR CO-ADAPT

Participant: Rémi Munos.

- *Title:* Brain computer co-adaptation for better interfaces
- *Type:* National Research Agency (ANR-09-EMER-002)
- *Coordinator:* Maureen Clerc
- *Other Partners:* Inria Odyssee project (Maureen Clerc), the INSERM U821 team (Olivier Bertrand), the Laboratory of Neurobiology of Cognition (CNRS) (Boris Burle) and the laboratory of Analysis, topology and probabilities (CNRS and University of Provence) (Bruno Torresani).

- *Web site:* <https://twiki-sop.inria.fr/twiki/bin/view/Projets/Athena/CoAdapt/WebHome>
- *Duration:* 2009-2014
- *Abstract:* The aim of Co-Adapt is to propose new directions for BCI design, by modeling explicitly the co-adaptation taking place between the user and the system. The goal of CoAdapt is to study the co-adaptation between a user and a BCI system in the course of training and operation. The quality of the interface will be judged according to several criteria (reliability, learning curve, error correction, bit rate). BCI will be considered under a joint perspective: the user's and the system's. From the user's brain activity, features must be extracted, and translated into commands to drive the BCI system. From the point of view of the system, it is important to devise adaptive learning strategies, because the brain activity is not stable in time. How to adapt the features in the course of BCI operation is a difficult and important topic of research. We will investigate Reinforcement Learning (RL) techniques to address the above questions.
- *Activity Report:* The performances of a BCI can vary greatly across users but also depend on the tasks used, making the problem of appropriate task selection an important issue. We develop an adaptive algorithm, UCB-classif, based on the stochastic bandit theory. This shortens the training stage, thereby allowing the exploration of a greater variety of tasks. By not wasting time on inefficient tasks, and focusing on the most promising ones, this algorithm results in a faster task selection and a more efficient use of the BCI training session. See [4] and <https://twiki-sop.inria.fr/twiki/bin/view/Projets/Athena/CoAdapt/WebHome>

8.1.3. ANR AMATIS

Participant: Pierre Chainais.

- *Title:* Multifractal Analysis and Applications to Signal and Image Processing
- *Type:* National Research Agency
- *Coordinator:* Univ. Paris-Est-Créteil (S. Jaffard)
- *Duration:* 2011-2015
- *Other Partners:* Univ. Paris-Est Créteil, Univ. Sciences et Technologies de Lille and Inria (Lille), ENST (Telecom ParisTech), Univ. Blaise Pascal (Clermont-Ferrand), and Univ. Bretagne Sud (Vannes), Statistical Signal Processing group at the Physics Department at the Ecole Normale Supérieure de Lyon, one researcher from the Math. Department of Institut National des Sciences Appliquées de Lyon and two researchers from the Laboratoire d'Analyse, Topologie et Probabilités (LAPT) of Aix-Marseille University.
- *Abstract:* Multifractal analysis refers to two concepts of different natures: On the theoretical side, it corresponds to pointwise singularity characterization and fractional dimension determination ; on the applied side, it is associated with scale invariance characterization, involving a family of parameters, the scaling function, used in classification or model selection. Following the seminal ideas of Parisi and Frisch in the mid-80s, these two components are usually related by a Legendre transform, stemming from a heuristic argument relying on large deviation and statistical thermodynamics principles: The multifractal formalism. This led to new theoretical approaches for the study of singularities of functions and measures, as well as efficient tools for classification and models selection, that allowed to settle longstanding issues (*e.g.*, concerning the modeling of fully developed turbulence). Though this formalism has been shown to hold for large classes of functions of widely different origins, the generality of its level of validity remains an open issue. Despite its popularity in applications, the interactions between theoretical developments and applications are unsatisfactory. Its use in image processing for instance is still in its infancy. This is partly due to discrepancy between the theoretical contributions mostly grounded in functional analysis and geometric measure theory, and applications naturally implying a stochastic or statistical framework. The AMATIS project aims at addressing these issues, by proposing a consistent and documented framework combining different theoretical approaches and bridging the gap towards applications. To that end, it will both address a number of challenging theoretical issues and devote significant efforts to elaborating a WEB

platform with softwares and documentation. It will combine the efforts of mathematicians with those of physicists and experts in signal and image processing. Dissemination among and interactions between scientific fields are also intended via the organization of summer schools and workshop.

- *Activity Report*: a collaboration with P. Bas (CR CNRS, LAGIS) deals with the steganalysis of textured images. While steganography aims at hiding a message within some support, *e.g.* a numerical image, steganalysis aims at detecting the presence or not of any hidden message in the support. Steganalysis involves two main tasks: first identify relevant features which may be sensitive to the presence of a hidden message, then use supervised classification to build a detector. While the steganalysis of usual images has been well studied, the case of textured images, for which multifractal models may be relevant, is much more difficult. Indeed, textured images have a rich and disordered content which favors hiding information in an unperceptible manner. A student internship of 8 months at Master level in 2012 has led us to consider a very fundamental question. Steganalysis is usually proceeded to a classification based on histograms of features (bag of words). We consider the problem of the optimization of the bins of such histograms with respect to the performance of the classifier. We have shown that a balanced version of K-means which fills each cell equally yields an efficient quantization to this respect [28].

8.1.4. National Partners

- Laboratoire de Mathématiques d'Orsay, France.
 - Mylène Maïda *Collaborator*
Ph. Preux has collaborated with M. Maïda and co-advised a student of the École Centrale de Lille. The motivation of this collaboration is the study of random matrices and the potential use of this theory in machine learning.
- LIF - CMI - Université de Provence.
 - Julien Audiffren *Collaborator*
M. Valko, A. Lazaric, and M. Ghavamzadeh work with Julien on Semi-Supervised Apprenticeship Learning. We have recently developed a maximum entropy algorithm that outperforms the approach without unlabeled data.
- Laboratoire Lagrange, Université de Nice, France.
 - Cédric Richard *Collaborator*
We have had collaboration on the topic of *dictionary learning over a sensor network*. We have published 2 conference papers [29] and [10].
- Laboratoire de Mécanique de Lille, Université de Lille 1, France.
 - Jean-Philippe Laval *Collaborator*
We co-supervise a starting PhD student (Linh Van Nguyen) on the topic of *high resolution field reconstruction from low resolution measurements in turbulent flows*.
- Biophotonics team at the Interdisciplinary Research Institute (IRI), Villeneuve d'Ascq, France.
 - Aymeric Leray *Collaborator*
We have co-supervised an intern student (Pierre Pfennig, 2 months) on the topic of *quantitative guarantees of a super resolution method via concentration inequalities*. A paper is submitted to ICASSP 2014.
- LAGIS, Ecole Centrale Lille - Université de Lille 1, France.
 - Patrick Bas *Collaborator*
We have a collaboration on the topic of *adaptive quantization to optimize classification from histograms of features with an application to the steganalysis of textured images*.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. *CompLACS*

Type: COOPERATION

Defi: Composing Learning for Artificial Cognitive Systems

Instrument: Specific Targeted Research Project

Objectif: Cognitive Systems and Robotics

Duration: March 2011 - February 2015

Coordinator: University College London

Partner:

- Centre for Computational Statistics and Machine Learning, University College London (United Kingdom)
- Department of Computer Science, University of Bristol (United Kingdom)
- Department of Computer Science, Royal Holloway, University of London (United Kingdom)
- SNN Machine Learning, Radboud Universiteit Nijmegen (The Netherlands)
- Institut für Softwaretechnik und Theoretische Informatik, TU Berlin (Germany)
- University of Leoben (Austria)
- Computer Science Department, Technische Universitaet Darmstadt (Germany)

Inria contact: Rémi MUNOS

Website: [COMPLACS](#)

Abstract: One of the aspirations of machine learning is to develop intelligent systems that can address a wide variety of control problems of many different types. However, although the community has developed successful technologies for many individual problems, these technologies have not previously been integrated into a unified framework. As a result, the technology used to specify, solve and analyse one control problem typically cannot be reused on a different problem. The community has fragmented into a diverse set of specialists with particular solutions to particular problems. The purpose of this project is to develop a unified toolkit for intelligent control in many different problem areas. This toolkit will incorporate many of the most successful approaches to a variety of important control problems within a single framework, including bandit problems, Markov Decision Processes (MDPs), Partially Observable MDPs (POMDPs), continuous stochastic control, and multi-agent systems. In addition, the toolkit will provide methods for the automatic construction of representations and capabilities, which can then be applied to any of these problem types. Finally, the toolkit will provide a generic interface to specifying problems and analysing performance, by mapping intuitive, human-understandable goals into machine-understandable objectives, and by mapping algorithm performance and regret back into human-understandable terms.

8.2.2. *Collaborations with Major European Organizations*

Alexandra Carpentier: University of Cambridge (UK).

Michal Valko collaborates with Alexandra on extreme event detection (such as network intrusion) with limited allocation capabilities.

Prof. Marcello Restelli and Prof. Nicola Gatti: Politecnico di Milano (Italy).

A. Lazaric continued his collaboration on transfer in reinforcement learning which is leading to an extended version of the last year work on transfer of samples in MDPs. Furthermore, we are going to submit an extended version of an application of multi-arm bandit in a strategic environment such as sponsored search auctions.

8.3. International Initiatives

8.3.1. Inria Associate Teams

- *Inria principal investigator*: Mohammad Ghavamzadeh and Rémi Munos
 - *Institution*: McGill university (Canada)
 - *Laboratory*: Reasoning and Learning Lab
 - *Principal investigator*:
 - * Prof. Joelle Pineau *Collaborator*
 - * Prof. Doina Precup *Collaborator*
 - * Amir massoud Farahmand *Collaborator*
- *Duration*: January 2013 - January 2015

8.3.2. Inria International Partners

8.3.2.1. Declared Inria International Partners

Ronald Ortner and Peter Auer: Montanuniversität Leoben (Austria).

Reinforcement learning (RL) deals with the problem of interacting with an unknown stochastic environment that occasionally provides rewards, with the goal of maximizing the cumulative reward. The problem is well-understood when the unknown environment is a finite-state Markov process. This collaboration is centered around reducing the general RL problem to this case.

In particular, the following problems are considered: representation learning, learning in continuous-state environments, bandit problems with dependent arms, and pure exploration in bandit problems. On each of these problems we have successfully collaborated in the past, and plan to sustain this collaboration possibly extending its scopes.

8.3.2.2. Informal International Partners

- eHarmony Research, California.
 - Václav Petříček *Collaborator*
Michal Valko has started to collaborate with eHarmony on sequential decision making for online dating and offline evaluation.
- University of Alberta, Edmonton, Alberta, Canada.
 - Csaba Szepesvári and Bernardo Avila Pires *Collaborator*
We have been collaborating on the topic of *risk bounds in cost-sensitive multiclass classification* this year. We have an accepted paper [8] at ICML.
- Technion - Israel Institute of Technology, Haifa, Israel.
 - Odalric-Ambrym Maillard *Collaborator*
Daniil Ryabko has worked with Odalric Maillard on representation learning for reinforcement learning problems. It led to a paper in AISTATS [21].
- School of Computer Science, Carnegie Mellon University, USA.
 - Prof. Emma Brunskill *Collaborator*
 - Mohammad Gheshlaghi Azar, PhD *Collaborator*
A. Lazaric started a profitable collaboration on transfer in multi-arm bandit and reinforcement learning which led to two publications at ECML and NIPS. We are currently working on extensions of the previous algorithms and development of novel regret minimisation algorithms in non-iid settings.
- Technicolor Research, Palo Alto.

- Branislav Kveton *Collaborator*
Michal Valko and Rémi Munos worked with Branislav on Spectral Bandits aimed at recommendation for the entertainment content recommendation. Michal continued the ongoing research on online semi-supervised learning and this year delivered the algorithm for a challenging single picture per person setting [19]. Victor Gabillon has spent 6 month at Technicolor as an intern to work on the sequential learning with submodularity, which resulted in 1 accepted paper at NIPS and two submissions to ICML.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

- Daniele Calandriello, student at Politecnico di Milano, Italy
Period: since April 2013.
He is working with A. Lazaric on multi-task reinforcement learning.

8.4.2. Visits to International Teams

- Rémi Munos, since July 2013, Microsoft Research New-England, USA
- Mohammad Ghavamzadeh, since November 2013, Adobe Research, San Jose, CA
- Victor Gabillon visited Technicolor research lab, Palo Alto, from March to September 2013.
- Azadeh Khaleghi visited Walt Disney Animation Studios, Burbank, from March to September 2013.

SIERRA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR: Calibration

Participant: Sylvain Arlot.

S. Arlot, Membre du projet ANR Calibration

Titre: Statistical calibration

Coordinator: University Paris Dauphine

Leader: Vincent Rivoirard

Other members: 34 members, mostly among CEREMADE (Paris Dauphine), Laboratoire Jean-Alexandre Dieudonné (Université de Nice) and Laboratoire de Mathématiques de l'Université Paris Sud

Instrument: ANR Blanc

Duration: Jan 2012 - Dec 2015

Total funding: 240 000 euros

Webpage: <https://sites.google.com/site/anrcalibration/>

8.1.2. CNRS: Gargantua

Participants: Sylvain Arlot, Francis Bach.

S. Arlot, F. Bach, membres du projet "Gargantua"

Titre: Big data; apprentissage automatique et optimisation mathématique pour les données gigantesques

Coordinator: Laboratoire Jean Kuntzmann (UMR 5224)

Leader: Zaid Harchaoui

Other members: 13 members: S. Arlot, F. Bach and researchers from Laboratoire Jean Kuntzmann, Laboratoire d'Informatique de Grenoble (Université Joseph Fourier) and Laboratoire Paul Painlevé (Université Lille 1).

Instrument: défi MASTODONS du CNRS

Duration: May 2013-Dec 2013 (may be reconducted for 2014)

Total funding: 30 000 euros for 2013

Webpage: <http://lear.inrialpes.fr/people/harchaoui/projects/gargantua/index.html>

8.2. European Initiatives

8.2.1. SIERRA

Participants: Francis Bach [correspondent], Simon Lacoste-Julien, Augustin Lefèvre, Nicolas Le Roux, Mark Schmidt.

Type: IDEAS

Instrument: ERC Starting Grant

Duration: December 2009 - November 2014

Coordinator: Inria (France)

Abstract: Machine learning is now a core part of many research domains, where the abundance of data has forced researchers to rely on automated processing of information. The main current paradigm of application of machine learning techniques consists in two sequential stages: in the representation phase, practitioners first build a large set of features and potential responses for model building or prediction. Then, in the learning phase, off-the-shelf algorithms are used to solve the appropriate data processing tasks. While this has led to significant advances in many domains, the potential of machine learning techniques is far from being reached.

8.2.2. SIPA

Participants: Alexandre d'Aspremont [correspondent], Fajwel Fogel.

Type: IDEAS

Instrument: ERC Starting Grant

Duration: May 2011 - May 2016

Coordinator: CNRS

Abstract: Interior point algorithms and a dramatic growth in computing power have revolutionized optimization in the last two decades. Highly nonlinear problems which were previously thought intractable are now routinely solved at reasonable scales. Semidefinite programs (i.e. linear programs on the cone of positive semidefinite matrices) are a perfect example of this trend: reasonably large, highly nonlinear but convex eigenvalue optimization problems are now solved efficiently by reliable numerical packages. This in turn means that a wide array of new applications for semidefinite programming have been discovered, mimicking the early development of linear programming. To cite only a few examples, semidefinite programs have been used to solve collaborative filtering problems (e.g. make personalized movie recommendations), approximate the solution of combinatorial programs, optimize the mixing rate of Markov chains over networks, infer dependence patterns from multivariate time series or produce optimal kernels in classification problems. These new applications also come with radically different algorithmic requirements. While interior point methods solve relatively small problems with a high precision, most recent applications of semidefinite programming in statistical learning for example form very large-scale problems with comparatively low precision targets, programs for which current algorithms cannot form even a single iteration. This proposal seeks to break this limit on problem size by deriving reliable first-order algorithms for solving large-scale semidefinite programs with a significantly lower cost per iteration, using for example subsampling techniques to considerably reduce the cost of forming gradients. Beyond these algorithmic challenges, the proposed research will focus heavily on applications of convex programming to statistical learning and signal processing theory where optimization and duality results quantify the statistical performance of coding or variable selection algorithms for example. Finally, another central goal of this work will be to produce efficient, customized algorithms for some key problems arising in machine learning and statistics.

8.3. International Initiatives

8.3.1. Inria Associate Team STATWEB

Title: Fast Statistical Analysis of Web Data via Sparse Learning

Inria principal investigator: Francis Bach

International Partner (Institution - Laboratory - Researcher):

University of California Berkeley (United States) - EECS and IEOR Departments - Francis Bach

Duration: 2011 - 2013

See also: <http://www.di.ens.fr/~fbach/statweb.html>

The goal of the proposed research is to provide web-based tools for the analysis and visualization of large corpora of text documents, with a focus on databases of news articles. We intend to use advanced algorithms, drawing from recent progresses in machine learning and statistics, to allow a user to quickly produce a short summary and associated timeline showing how a certain topic is described in news media. We are also interested in unsupervised learning techniques that allow a user to understand the difference between several different news sources, topics or documents.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Michael Jordan ([U.C. Berkeley](#)), spent one year in our team, until the summer 2013, financed by the Fondation de Sciences Mathématiques de Paris and Inria.

TAO Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- **TIMCO** – 2012-2015 (432kEuros for TAO). Technology for In Memory Computing. A NUMA architecture with very large memory. FUI project, Coordinator Bull SA, WP *Algorithm adaptation: the paradigm shift* coordinator Cécile Germain.

8.2. National Initiatives

- **ASAP** – 2009-2013 (178 kEuros). *Apprentissage Statistique par une Architecture Profonde*, ANR programme DEFIS 2009 Coordinator Alain Rakotomamonjy, LITIS, Université de Rouen, France; Participants: Sylvain Chevallier, Hélène Paugam-Moisy, Sébastien Rebecchi, Michèle Sebag.
- **IOMCA** – 2010-2013 (264 kEuros). Including Ontologies in Monte-Carlo Tree Search and Applications, ANR international project coordinated by O. Teytaud (TAO, Inria). Participants: Adrien Couëtoux, O. Teytaud.
- **DESCARWIN** – 2010-2013 (201 kEuros). Coordinateur P. Savéant, Thalès R&T. Participants: Mostepha-Redouane Khouadjia, Marc Schoenauer.
- **SIMINOLE** – 2010-2014 (1180kEuros, 250kEuros for TAO). Large-scale simulation-based probabilistic inference, optimization, and discriminative learning with applications in experimental physics, ANR project, Coordinator B. Kégl (CNRS LAL). Participants: Balázs Kégl, Djalel Benbouzid, Nikolaus Hansen, Michèle Sebag, Cécile Germain-Renaud
- **NUMBBO** – 2012-2016 (290kEuros for TAO). Analysis, Improvement and Evaluation of Numerical Blackbox Optimizers, ANR project, Coordinator Anne Auger, Inria. Other partners: Dolphin, Inria Lille, Ecole des Mines de Saint-Etienne, TU Dortmund
Participants: Anne Auger, Nikolaus Hansen, Marc Schoenauer, Ouassim Ait ElHara
- **LOGIMA** – 2012-2016 (136kEuros for TAO). Logics, structural representations, mathematical morphology and uncertainty for semantic interpretation of images and videos, ANR project, Coordinator Céline Hudelot, MAS-ECP. Other partners: TAO, LTCI-Telecom ParisTech
Local coordinator: Jamal Atif

8.2.1. Other

- **GO** – (2011-2013) *Observatoire de la Grille Action de Développement technologique* Inria. Coordinator Cécile Germain-Renaud. Participants: Dawei Feng, Julien Nauroy, Michèle Sebag. Also funded by the France Grilles national initiative.

8.3. European Initiatives

8.3.1. FP7 Projects

- **SYMBRION**
Type: COOPERATION (Integrated Project)
Program: Embedded systems design
Instrument: Integrated Project
Objective: FET proactive: Pervasive adaptation
Duration: February 2008 - July 2013

Coordinator: Sergey Kornienko and Paul Levi, Stuttgart University (Germany).

Partners: Universität Stuttgart (USTUTT), Universität Graz (IZG), Vrije Universiteit (VU), Universität Karlsruhe (UNIKARL), Flanders Institute for Biotechnology (VIB), University of the West of England, Bristol (UWE), Eberhard Karls Universität Tübingen (UT), University of York (UY), Université Libre de Bruxelles (CENOLI), and Inria-TAO.

Inria contact: M. Schoenauer

Abstract: SYMBRION, an FP7 IP (Integrated Project), involving 10 partners from Robotics (Electronics and Mechanics), Evolutionary Biology, and Computer Science (working on bio-inspired complex systems). Integrating hardware and software design, Symbion IP aims at designing autonomous swarm robots. The software will involve both time-scales of evolutionary learning and on-line learning, in direct connection with TAO research themes.

- **CitInES**

Type: COOPERATION (STREP)

Program: Design of a decision support tool for sustainable, reliable and cost-effective energy strategies in cities and industrial complexes

Instrument: Specific Targeted Research Project

Objective: ICT systems for energy efficiency

Duration: October 2011 - March 2014

Coordinator: Artelys (SME)

Other Partners: AIT (Austria), INESC Porto (Portugal), ARMINES (France), Schneider Electric SAS (France), Comune di Cesena (Italy), Comune di Bologna (Italy), TUPRAS (Turkey), ERVET (Italy)

Inria contact: Olivier Teytaud

Abstract: The overall objective of CitInES is to design and demonstrate a multi-scale multi-energy decision-making tool to optimise the energy efficiency of cities or large industrial complexes by enabling them to define sustainable, reliable and cost-effective long-term energy strategies. Demonstrations will take place in two cities in Italy, Cesena and Bologna, and in one oil refinery in Turkey, Tupras. Innovative energy system modelling and optimization algorithms will be designed to allow end-users to optimize their energy strategy through detailed simulations of local energy production, storage, transport, distribution and consumption, including demand side management and coordination functionalities enabled by smart grid technologies. All energy vectors (electricity, gas, heat...), usages (heating, air conditioning, lighting, transportation...) and sectors (residential, industrial, tertiary, urban infrastructure) will be considered to draw a holistic map of the city/industry energy behaviour. Energy strategy analyses will encompass advanced long-term risk analysis. As economic and technical situations are constantly evolving, a relevant energy strategy should be robust to different prospective scenarios. Hence, a diversified energy portfolio will allow city and industry authorities to react more efficiently to fuel price stresses and to decrease their exposition to a given energy solution. The expected impacts on end-users are threefold : 1) to assess the economic and environmental impacts of urban planning scenarios in terms of energy; 2) to optimise their local energy strategy to cost-effectively reduce CO2 emissions, including usage of local renewable energies, electric mobility integration, multi-energy coordination, smart grid integration and demand-side management; and 3) to assess financial and environmental long-term risks and propose robust energy schemes to face fuel and CO2 price uncertainties. The developed software will also be used as a communication tool for end-users to facilitate consultations between actors and to promote local authority decisions towards citizens. CitInES methodology will be demonstrated by optimizing long-term energy strategies for the two partner cities and for the partner oil refinery. The proposed strategies will be assessed and compared to initial end-user strategies to measure energy and CO2 emission savings.

- **EGI**

Program: Collaborative Project and Coordination and Support Action (CP-CSA)

Project acronym: EGI-Inspire

Project title: European Grid Infrastructures

Duration: May 2010 - April 2014

Coordinator: Steven Newhouse EGI.eu

Other Partners: 40 in Europe and 8 more worldwide (details on <http://www.egi.eu>)

Inria contact: Cécile Germain

Abstract: Collaborative effort involving more than 50 institutions in over 40 countries. Its mission is to establish a sustainable European Grid Infrastructure (EGI). EGI-InSPIRE is ideally placed to join together the new Distributed Computing Infrastructures (DCIs) such as clouds, supercomputing networks and desktop grids, for the benefit of user communities within the European Research Area.

- **Network of Excellence PASCAL**

Type: COOPERATION (FP7)

Program: Pattern Analysis, Statistical Modelling and Computational Learning

Instrument:

Objective: PASCAL is a Network of Excellence funded by the European Union. It has established a distributed institute that brings together researchers and students across Europe, and is now reaching out to countries all over the world.

Duration: March 2008 - July 2013

Coordinator: John Shawe-Taylor, (Scientific coordinator), University College London, UK and Steve Gunn (Operational), University of Southampton, UK

Other Partners:

Inria contact: Michèle Sebag

Abstract: PASCAL is developing the expertise and scientific results that will help create new technologies such as intelligent interfaces and adaptive cognitive systems. To achieve this, it supports and encourages collaboration between experts in Machine Learning, Statistics and Optimization. It also promotes the use of Machine Learning in many relevant application domains such as Machine vision, Speech, Haptics, Brain-Computer Interface, User-modeling for computer human interaction, Multimodal integration, Natural Language Processing, Information Retrieval, Textual Information Access.

- **MASH**

Program: Investigation of the design of complex learning systems to increase the performance of artificial intelligence

Project acronym: MASH

Project title: Massive Sets of Heuristics

Duration: October 2010 - June 2013

Coordinator: Idiap Research Institute (Martigny, Switzerland)

Other Partners: Heudiasyc laboratory (CNRS and UTC, Compiègne, France), University of Potsdam (Germany), Center for Machine Perception of the Czech Technical University, Prague.

Inria contact: Olivier Teytaud

Abstract: The goal of the MASH project is to create new tools for the collaborative development of large families of feature extractors. It aims at starting a new generation of learning software with great prior model complexity. The project is structured around this web platform. It comprises collaborative tools, such as a wiki-based documentation and a forum, and an experiment center to run and analyze experiments continuously. The applications targeted by the project are classical vision problems, and goal-planning in a 3D video game and with a real robotic arm. The scientific issues to be tackled along the course of the project are numerous, from standard Machine Learning questions such as learning and prediction with very large feature spaces and tight computational constraints, to original problems related to clustering in a functional space.

8.3.2. Collaborations in European Programs, except FP7

Program: COST

Project acronym: IC0804

Project title: Energy efficiency in large scale distributed systems

Duration: January 2009 - May 2013

Coordinator: Jean-Marc Pierson IRIT

Other partners: see <http://www.cost804.org>.

Abstract: The COST Action IC0804 proposes realistic energy-efficient alternate solutions to share IT distributed resources. While much effort is nowadays put into hardware specific solutions to lower energy consumptions, a complementary approach is necessary at the distributed system level, i.e., middleware, network and applications. The Action characterizes the energy consumption and energy efficiencies of these components.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. INDEMA

Title: Intelligent Decision Making Mechanisms with Hidden Information, and Application to Electricity Generation

Inria principal investigator: Olivier Teytaud

International Partner: National University of Tainan (Taiwan)

Duration: 2012 - 2014

See also: <http://www.lri.fr/~teytaud/taiwanday2.html>

The objectives of the project are threefolds:

- Objective 1: Designing consistent iterative realistic algorithms for partially observable 1-player or 2-player games. We mean:
 - consistent algorithms, in the sense that they are mathematically, provably, optimal asymptotically in the computation time.
 - iterative algorithms in the sense that when you give more time to the algorithm, it should be better; and with little time, it should do its best for replying something acceptable. This is also termed an anytime algorithm. Most algorithm which survive decades are iterative.
 - realistic algorithms; we mean that one can easily design a consistent iterative algorithm that will never work in practice in a real-world setting; so, additionally, we want an algorithm which looks reasonable and we refer to the second objective for the assesment of this property.

- Objective 2: Impressive visible applications, e.g., applications in games or puzzles, because such games are very clear assessment tools. Possibilities include Minesweeper (on which we believe that much progress is still possible), Chinese Dark Chess, Kriegspiel, Phantom-Go, card games. Such nice results are critical for advertising and assessing our research.
- Objective 3: Big industrial applications. Having both mathematics and visible realizations in games and industrial applications might be considered as too much; yet, we have chosen to request the maximum possible funding and to include many people in the travelling; also, the persons in the project are all people working in related subjects, with various terminologies, and we already have concrete applications in mind, just far enough from our past activities for being new (we want to tackle in a principled manner partial observability which was somehow ignored in many past works) and close enough for strongly reducing the "warm up" time. In the fully observable case, we worked successfully for these three objectives and want to do the same in the partially observable case. More precisely, when working on real applications in the field of energy generation, we have seen that many problems are simplified so that they boil down to fully observable problems, but that this is a bad application; and our solvers must include some tricks for the partial observability. This is the main motivation for this project; we assume that mathematical analysis can be done on this (objective 1); that it will provide big results in games (objective 2) where many main programs are based on non-consistent algorithms. We believe that requirements above (objective 1) and visible realizations will facilitate the migration to real-world application; also we point out that previous research projects involving us facilitated contacts with industry, in particular in the field of energy generation, which is a key point for this third objective. A roadmap for objective 3 is as follows:
 - Check on simple versions of energy production problems whether the fully observable approximation is ok. We guess that in many cases it is not ok, and we want to clearly state to which extent (by how many percents) we loose in terms of loss function.
 - Experiment our algorithms on real industrial problems. We will work both on Taiwan-centered and on Europe-Centered electricity generation problems in order to widen the scope of the analysis and so that both partners can be helpful in terms of applications in their own countries.

Some continuously updated and more detailed descriptions of several works in progress can be found at <http://www.lri.fr/~teytaud/indema.html>.

8.4.2. Inria International Partners

- On-going collaboration with Christian Schulte (KTH, Stockholm), one of the main developers of the GECODE Constraint Programming platform (see Section 6.2).
- Shinshu University, Faculty of Engineering, project *Global Research on the Framework of Evolutionary Solution Search to Accelerate Innovation*, from the "Strategic Young Researcher Overseas Visits Program for Accelerating Brain Circulation" program, in which TAO and DOLPHIN (Inria Lille) are partner labs and will host Japanese students in the forthcoming 4 years.

8.4.3. Inria International Labs

Olivier Teytaud, 10 days in Inria Chile: meetings with several companies and institutes. They were followed by video-conferences with Endesa and email discussions between our partner Artelys and Cedec-Sing.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Visit of a Taiwanese delegation, about power systems and E-learning mainly; more information at <http://www.lri.fr/~teytaud/france2013.html>. Contact: O. Teytaud.

- Visit of a delegation of Shinshu University, Faculty of Engineering, including Dr. Miura (University Trustee and VP), Dr. Tanaka, coordinator of the *Global Research on the Framework of Evolutionary Solution Search to Accelerate Innovation* project (see above).

8.5.2. Visits to International Teams

- **Olivier Teytaud**, invited research fellow, National Dong Hwa University, 4.5 months, 2013.

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.

ASPI Project-Team

7. Partnerships and Cooperations

7.1. National initiatives

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

Participant: Florent Malrieu.

January 2013 to December 2016.

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

7.2. International initiatives

7.2.1. Inria international partners

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

7.3. International research visitors

7.3.1. Visits to international teams

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

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

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 contrast a Brain-Computer Interface (BCI) based on synthesized music to modify alertness 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, Dercion 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).

MATHRISK Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

B. Jourdain is involved in the ANR Stab (2013/2016). Partners: Lyon1 and Paris-Dauphine.

8.1.2. Competitvity Clusters

Pôle Finance Innovation.

8.2. International Initiatives

8.2.1. Inria International Partners

8.2.1.1. Informal International Partners

- Center of Excellence program in Mathematics and Life Sciences at the Department of Mathematics, University of Oslo, Norway, (with B. Øksendal).
- Department of Mathematics, University of Manchester (with Tusheng Zhang, currently in charge of an EU-ITN program on BSDEs and Applications).
- Mannheim University (with Alexander Schied, Chair of Mathematics in Business and Economics, Department of Mathematics)
- Roma Tor Vergata University (Lucia Caramellino)
- Amsterdam University (Michel Velekoop)
- Delft University (Kees Oosterlee)
- Mexico University and CIMAT (Begonia Fernandez)
- Osaka and Ritsumeikan University (A. Kohatsu-Higa).
- Shandong University, China (Z. Chen)

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- Alexander Schied, Mannheim University,
- Andreea Minca, Cornell University,
- Xin Guo, Berkeley University,
- Arturo Kohatsu Higa, Ritsumeikan University,
- Luis Ortiz Gracia, CWI - Centrum voor Wiskunde en Informatica, Amsterdam,
- Karel in 't Hout, University of Antwerpen,
- Lucia Caramellino, Tor Vergata University, Roma.

REGULARITY Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

Erick Herbin is member of the CNRS Research Groups:

- GDR Mascot Num, devoted to stochastic analysis methods for codes and numerical treatment;
- GDR Math-Entreprise, devoted to mathematical modeling of industrial issues.

8.2. International Initiatives

8.2.1. Inria International Partners

8.2.1.1. Informal International Partners

- Regularity collaborates with Bar Ilan university on theoretical developments around set-indexed fractional Brownian motion and set-indexed Lévy processes. The PhD thesis of Alexandre Richard is co-supervised by Erick Herbin and Ely Merzbach.
- Regularity collaborates with Michigan State University (Prof. Yimin Xiao) on the study of fine regularity of multiparameter fractional Brownian motion.
- Regularity collaborates with St Andrews University (Prof. Kenneth Falconer) on the study of multistable processes.
- Regularity collaborates with Acadia University (Prof. Franklin Mendivil) on the study of fractal strings, certain fractals sets, and the study of the regularization dimension.
- Regularity collaborates with Milan University (Prof. Davide La Torre) on the study of certain economic growth models.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

Ely Merzbach (Bar-Ilan University) visited the team for one month.

TOSCA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- N. Champagnat, J. Claisse and D. Villemonais are members of the ANR MANEGE (Modèles Aléatoires en Écologie, Génétique et Évolution, ending in April 2014) whose aim is to provide methodological and conceptual advances in the study of stochastic processes modeling ecology, population genetics and evolution of life. This work is sustained by regular exchanges with biologists from several teams in France. In addition, the three working groups that operate in each of the three poles of the MANEGE project (Paris, Palaiseau, Marseille) gather all local probabilistic interests in the issues of this project. http://www.cmap.polytechnique.fr/~anr-manege/index_en.html
- A. Lejay is member of the ANR SIMUDMRI (Simulation of diffusion MRI signals in biological tissues) which started in November 2010 (directed by Jing-Rebecca Li, Inria Rocquencourt). <http://www.cmap.polytechnique.fr/~jingrebeccali/grants/simudmri.html>
- A. Lejay is member of the ANR H2MNO4 (ANR Cosinus, 2012–2015) on Original Optimized Object Oriented Numerical Model for Heterogeneous Hydrogeology which started in November 2012 (directed by Joceyline Erhel, IRISA, Rennes).

8.1.2. Contract with ADEME

Participant: Mireille Bossy.

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

Concerning the Inria workpackage, in collaboration with Antoine Rousseau, from the project-team MOISE, M. Bossy introduced the terrain elevation in the SDM modelling. Selim Kraria is starting to work in MODÉOL. This year we also work on the interface of SDM with the classical and widely used numerical weather prediction solver WRF. For the visualisation purpose with the SDM outputs, we also retained the NUM3SIS platform developed at Inria Sophia Antipolis - Méditerranée.

8.2. International Initiatives

8.2.1. Inria Associate Teams

8.2.1.1. ANESTOC

Title: Stochastic modelling of renewable energies

Inria principal investigator: Denis Talay

International Partner (Institution - Laboratory - Researcher):

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

Duration: 2011 - 2013

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

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

8.2.1.2. Informal International Partners

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

8.2.2. Inria International Labs

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

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

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

8.2.3. Participation In other International Programs

8.2.3.1. Math Amsud project SIN

Participant: Etienne Tanré.

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

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

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- The TOSCA *seminar* organized by J. Inglis in Sophia Antipolis has received the following speakers: Eric Luçon (Technische Universität, Berlin), Julien Reygner (UPMC), Khaled Bahlali (Université du Sud Toulon-Var), Bertrand Cloez (Laboratoire d'Analyse et de Mathématiques Appliquées Université Paris-Est - Marne-la-Vallée), Michael Mascagni (Florida State University), Camillo Garcia Trillos (Laboratoire J.A. Dieudonné Nice), Pierre Guiraud (CIMFAV Facultad de Ingeniería, Universidad de Valparaíso), Laurent Michel (Laboratoire J.A. Dieudonné Nice), François Delarue (Laboratoire J.A. Dieudonné Nice).
- L. Beznea (Simion Stoilow of the Institute of Mathematics of the Romanian Academy) has been visiting TOSCA Nancy for two weeks in May and June.

8.3.1.1. Internships

Jonathan Alif

Subject: Étude des grandes variations du modèle de Heston

Date: from May 2013 until August 2013

Institution: Université de Lorraine

Maimoun Ben Taher

Subject: Real options for electricity production

Date: from Feb 2013 until May 2013

Institution: École Polytechnique de Tunisie (Tunisia)

Louis Capietto

Subject: Networks with several populations of neurons

Date: January-June 2013

Institution: École Centrale de Lyon

Benoît Henry

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

Date: from March 2013 until September 2013

Institution: Université de Lorraine

Alexis Papic

Subject: First Passage Times

Date: March 2013

Institution: PUC (Chile)

Khaled Salhi

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

Date: from March 2013 until September 2013

Institution: Université de Lorraine

Shih Hau Tan

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

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

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

8.3.2. Visits to International Teams

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