Activity Report 2012

Section Contracts and Grants with Industry

COMPUTATIONAL MODELS AND SIMULATION

MODELING, OPTIMIZATION, AND CONTROL OF DYNAMIC SYSTEMS

OPTIMIZATION, LEARNING AND STATISTICAL METHODS

STOCHASTIC METHODS AND MODELS

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

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

The research department of VolksWagen AG uses the `OpenFOAM` fluid dynamics code, among other software. The parallel version of this code relies on `Scotch` to distribute mesh data across processors. When running their simulations, the engineers of VW in charge of running numerical simulations have noticed load imbalance among the processors, and would like to have this problem solved in order to achieve better machine utilization.

The purpose of this contract is to investigate the potential causes of the evidenced imbalance, and to find remedies to it. The proposed solutions should be integrated in the trunks of `Scotch` and/or of `OpenFOAM`. This contract started in April and ended in December.

CAD Team

7. Bilateral Contracts and Grants with Industry

7.1. EADS

We cooperate with EADS on geometric representation and FEM.

7.2. CAS-BEGCL Imaging Technology Corporation

We cooperate with CAS-BEGCL Imaging Technology Corporation on fluid simulation, object deformation and realistic rendering.

7.3. ANR/ NSFC AND SYSTEM@TIC: 2010-2013

The objectives of these Programs address Geometry Modeling and Computing, mainly Robustness and Tolerance as well as Geometric Uncertainties.

CAGIRE Team (section vide)

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

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

We have started a collaboration with the SME (Small and Medium Enterprise) AxesSim on the development of Maxwell solvers. AxesSim is specialized on scientific software for airplane electromagnetic compatibility. For the moment, one CIFRE thesis is supported by DGA. Gary Cohen from Inria Rocquencourt is also involved in the project.

CASTOR Team (section vide)

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

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

- ANDRA

  In 2011/12, S. Krell and T. Goudon, with A. Gloria, have worked on the development of homogenization methods for the simulation of the transport of radionucleides in porous media. A new numerical method has been proposed, based on Reduced Basis techniques which allows efficient computation of the (space-dependent) effective coefficients. In 2012/13 we start a new collaboration devoted to the modeling and simulation of ventilation devices in nuclear waste disposal. This is a long–term project (with the PhD of Y. Zhang) which aims at solving numerically systems of PDEs describing mass and heat transfer between porous media and ventilation channels. Generally speaking ANDRA has strong needs of numerical tools for simulating transient water/gas flows (with typical applications to understand gas flows emanating from corroded confining devices in nuclear waste disposal and mass/heat exchanges in circulation channels). The performances and flexibility of the commercial code `Tough2` are definitely too restricted. It is likely that fostering the skills of several Inria teams working on these topics can be decisive to design new two-phase codes using modern schemes and complex meshes, with domain decomposition methods and parallel procedures.

- CEA

  We work on the simulation of two-phase flows described by Eulerian/Lagrangian models. To this end, A. Champmartin develops a new semi-Lagrangian algorithm for fluid-kinetic coupling, in collaboration with CEA/DAM and the LRC Manon.

- GDFSuez EP-Storengy - (Contract with UNS-CNRS)

  The collaboration is devoted to the control of rock permeability by polymer injections, and to the simulation of flows in tight rocks, with weak permeabilities. These questions lead to consider highly heterogeneous and fractured media; in turn simulations should use highly unstructured meshes. During her post-doc, C. Guichard develops new methods for diphasic flows in porous media, with application to tight gas and gas stockage.

- TOTAL (Contract with UNS-CNRS)

  R. Masson is scientific consultant of the recently created team "Nouveau Simulateur de Réservoir", led by B. Faissat. The team is concerned with the development of new research codes for oil recovery problems, based on FV methods. Through the post doc of W. Kherriji, we develop new domain decomposition algorithm for the simulation of oil recovery, with local refinement, both in time and space. C. Guichard works on Finite Volumes methods on unstructured meshes.

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

7. Bilateral Contracts and Grants with Industry

7.1. Optimal (Aerospace Valley)

Participants: Roland Becker, Kossivi Gokpi, Robert Luce, Eric Schall, David Trujillo.

Optimal is a research project related to the cooling of the stator of a turbomachinery. Both physical experiments and numerical simulations are employed. This project has three industrial (Liebherr, Epsilon, and SIBI) and three academic partners (Universities of Pau, Poitiers, and Toulouse). It has been evaluated by the cluster Aerospace Valley. The PhD-thesis of Kossivi Gokpi is financed by this project.
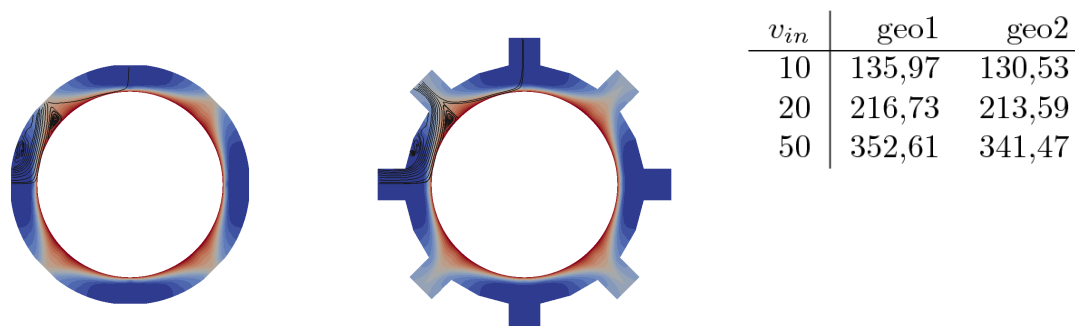
v_{in}	geo1	geo2
10	135,97	130,53
20	216,73	213,59
50	352,61	341,47

Figure 15. Temperature field and recirculation for two geometries and computed Nusselt numbers for different inflow velocities.

Our contributions concern the numerical simulation of the viscous flow in different geometrical configurations. Comparison with experimental data will be investigated with respect to the Nusselt number. The computed temperature and streamlines for typical geometries are shown in Figure 15 . In addition, the computed Nusselt numbers for the two configurations and varying inflow velocities are given.

Among the different questions concerning modeling such as the boundary conditions at the in- and outlets and the sensitivity to the geometry, a particular point of interest is the study of compressibility effects.

The experimental part of the product is conducted in collaboration with Mathieu Mory, professor at UPPA, and the post-doctoral position of Stéphane Soubacq, who started to work in 10/2009, is financed by the project. The modeling and numerical simulation is done in collaboration with Abdellah Saboni, professor at UPPA.

7.2. Fractured reservoir (Total)

Participants: Robert Luce, David Trujillo.

We have developed specific meshing tools in order to take into account the interaction between faults and a petroleum reservoir for the company Total. This work was done in collaboration with Eric Dubach and Pierre Puiseux from LMA.
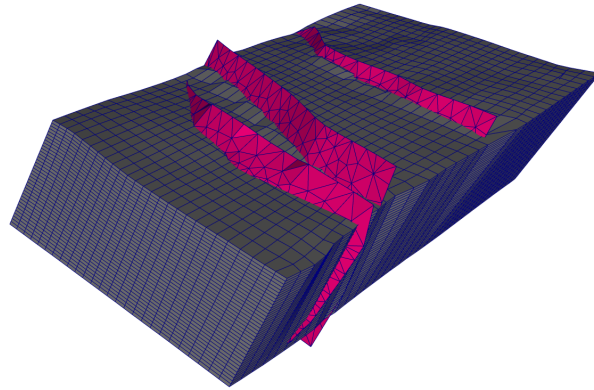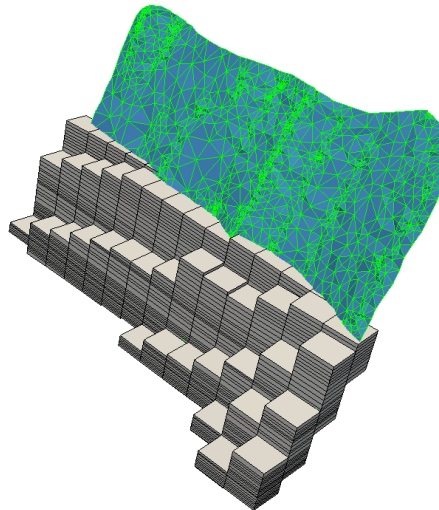
Figure 16. Fractured reservoir

Figure 17. Intersection between fault and reservoir

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

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Gregoire Allaire is in charge of the RODIN project. This is a consortium of various companies and universities which has been sponsored by the FUI AAP 13 for 3 years, starting on July 2012. The industrial partners are: Renault, EADS, ESI, Eurodecision, Alneos, DPS. The academic partners are: CMAP at Ecole Polytechnique, Laboratoire J.-L. Lions at Paris 6 and 7 Universities, centre de recherches Bordeaux Su-Ouest at Inria. The goal of the RODIN project is to perform research and develop a computer code on geometry and topology optimization of solid structures, based on the level set method. RODIN is the acronym of "Robust structural Optimization for Design in INdustry".

- Grègoire Allaire has a contract with IFPEN on multiscale finite elements for two-phase flows in porous media (in the framework of the PhD thesis of F. Ouaki, to be defended in 2013).

- Grègoire Allaire has a contract with EADS/IW on topology optimization for composite panels drapping (in the framework of the PhD thesis of G. Delgado, to be defended in 2013).

- Grègoire Allaire has a contract with Renault on geometry and topology optimization of structures (in the framework of the two PhD theses of Ch. Dapogny, with the co-advising of P. Frey, to be defended in 2013, and G. Michailidis, with the co-advising of F. Jouve, to be defended in 2013).

- Houssem Haddar is in charge of DEFI part of the FUI project Nanolytix. This three years project started in October 2012 and involves Xenocs (coordinator), imXPAD, Arkema, Inria (DEFI) and CEA-Leti. It aims at building a compact and easy-to use device that images nonaparticles using X-ray diffraction at small or wide angles (SAXS and WAXS technologies). We are in charge of direct and inverse simulation of the SAXS and WAXS experiments.

- Houssem Haddar is in charge of the electormagnetic simulation work package of the FUI project Tandem. This three years project started in December 2012 and involves Bull-Amesys (coordinator), BOWEN (ERTE+SART), Ecole Polytechnique (CMAP), Inria, LEAT et VSM. It aims at constructing a radar system on a flying device capable of real-time imaging mines embedded in dry soils (up to 40 cm deep). We are in charge of numerical validation of the inverse simulator.

- Houssem Haddar has a contract with EDF R&D on non destructive testing of concrete materials (in the framework of the PhD thesis of Lorenzo Audibert, to be defended in 2015)

- Houssem Haddar has a contract with EDF R&D on data assimilation for temprature estimates in nuclear reactors (in the framework of the PhD thesis of Thibault Mercier, to be defended in 2015)

- Houssem Haddar is coordinating the contract EDF R&D on non eddy current non destructive testing. This contract involves Zixian Jiang (PhD to be defended in 2013) and a two years PostDoc, Kamel Riahi.

7.2. Bilateral Grants with Industry

- Grègoire Allaire is a scientific adviser at the DM2S department of CEA Sacaly.

<p style="text-align:center">**GAMMA3 Project-Team**</p>

4. Bilateral Contracts and Grants with Industry

4.1. Bilateral Contracts with Industry

- ANDRA, partenariat stratégique, projet 2, *Maillage adaptatif hexaédrique du milieu géologique multicouche avec prise en compte des ouvrages de stockage et des évolutions géodynamiques*, P. Laug et H. Borouchaki, 48 k-euros, 12/07/2011 - 12/09/2012.
- DASSAULT, *Maillage surfacique et topologie*, P. Laug et H. Borouchaki, 33 k-euros, 01/01/2010 - 31/12/2012.
- LECTRA, *Redéfinition des domaines de paramètres*, P. Laug et H. Borouchaki, 6 k-euros, 20/09/2011 - 19/09/2012.

4.2. Bilateral Grants with Industry

- Fondation EADS Grant, F. Alauzet, 150 k-euros, 2012-2015
- Fondation EADS Grant, A. Loseille, 140 k-euros, 2012-2015

IPSO Project-Team (section vide)

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MC2 Project-Team

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7. Bilateral Contracts and Grants with Industry

7.1. Program PREDIT

Participants: Charles-Henri Bruneau, Iraj Mortazavi.

Program PREDIT ADEME with Renault and Peugeot. The aim of this program is the work on drag reduction in order to decrease the fuel consumption.

7.2. Renault

Participants: Charles-Henri Bruneau, Iraj Mortazavi.

CARAVAJE project with ADEME (PREDIT Véhicules propres et économes) notified october 24th 2008. Collaboration with Renault and Peugeot, two PME and 3 labs to reduce the drag coefficient of a ground vehicle. 95 k euros for 3 years.

7.3. Plastic Omnium

Participant: Iraj Mortazavi.

The MC2 team works actually with the Plastic Omnium company in order to study the flow behaviour around square back ground vehicles (like buses, camions,...) using LES and DNS techniques. The main target of this collaboration is to identify the structures of velocity fields that generate aerodynamical losses, in order to design drag reduction control strategies using pulsed or synthetic jets. In the framework of this project, we also want to compute accurately instantaneous velocity fields, with high velocities. The computations should be performed on long time for complex geometries. A part of this work is included in the PhD thesis of Yoann Eulalie.

7.4. Contracts with Industry

Thierry Colin is Scientific consulting for the CEA CESTA. The CEA is funding the thesis of M. Latige and a grand of 30 k euros has been obtained.

Angelo Iollo is consulting with OPTIMAD engineering.

7.5. Grants with Industry

CIFRE - Conventions Industrielles de Formation par la REcherche - with VALEOL (VALOREM Group)

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

6. Bilateral Contracts and Grants with Industry

6.1. Contracts and Grants with Industry

Many research activities of the project-team are conducted in close collaboration with private or public companies. The project-team is also supported by Office of Naval Research and European Office of Aerospace Research and Development, for multiscale simulations of random materials. All these contracts are operated at and administrated by the Ecole des Ponts.

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

7. Bilateral Contracts and Grants with Industry

7.1. High order DGTD-$\mathbb{P}_p$ Maxwell solver for numerical dosimetry studies

Participants: Stéphane Lanteri, Joe Wiart [WHIST Laboratory, Orange Labs, Issy-les-Moulineaux].

The objective of this research grant with the WHIST (Wave Human Interactions and Telecommunications) Laboratory at Orange Labs in Issy-les-Moulineaux is the adaptation of a high order DGTD-$\mathbb{P}_p$ method on tetrahedral meshes developed in the team and its application to numerical dosimetry studies in the context of human exposure to electromagnetic waves emitted from wireless systems. These studies involve realistic geometrical models of human tissues built from medical images.

7.2. Seismic risk assessment by a discontinuous Galerkin method

Participants: Nathalie Glinsky, Stéphane Lanteri, Fabien Peyrusse.

The objective of this research grant with IFSTTAR http://www.ifsttar.fr (French institute of sciences and technology for transport, development and networks) and CETE Méditerranée is the numerical modeling of earthquake dynamics taking into account realistic physical models of geological media relevant to this context. In particular, a discontinuous Galerkin method will be designed for the solution of the elastodynamic equations coupled to an appropriate model of physical attenuation of the wave fields for the characterization of a viscoelastic material.

7.3. High order DGTD-$\mathbb{P}_p$ Maxwell solver for electric vulnerability studies

Participants: Loula Fezoui, Stéphane Lanteri, Muriel Sesques [CEA/CESTA, Bordeaux].

The objective of this research grant with CEA/CESTA in Bordeaux is the development of a coupled Vlasov-Maxwell solver combining the high order DGTD-$\mathbb{P}_p$ method on tetrahedral meshes developed in the team and a Particle-In-Cell method. The resulting DGTD-$\mathbb{P}_p$/PIC solver is used for electrical vulnerability assessment of the experimental chamber of the *Laser Mégajoule* system.

NANO-D Team (section vide)

OPALE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

ArcelorMittal-Inria industrial contract n. 5013 : Opale started a thorough collaboration in optimal design of high performance steel with the mentioned world leader industrial. The aim of the collaboration is to develop and study new and efficient tools dedicated to multicriteria shape optimization of structures which undergo large non-linear elasto-plastic deformations.

The present contract has three years duration and funds the Ph.D. thesis of Aalae Benki and Research financial support.

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POEMS Project-Team

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7. Bilateral Contracts and Grants with Industry

7.1. Contract POEMS-CEA-LIST-2

Participant: Anne-Sophie Bonnet-Ben Dhia.

Start : 09/01/2010, End : 07/31/2013. Administrator : ENSTA.
This contract is about the scattering of elastic waves by a stiffener in an anisotropic plate.

7.2. Contract POEMS-CEA-LIST-3

Participants: Laurent Bourgeois, Eric Lunéville.

Start : 10/01/2011, End : 09/30/2012. Administrator : ENSTA.
This contract is about the linear sampling methods for elastic waveguides.

7.3. Contract POEMS-CEA-LIST-DIGITEO

Participants: Anne-Sophie Bonnet-Ben Dhia, Sonia Fliss, Antoine Tonnoir.

Start : 10/01/2011, End : 09/30/2014. Administrator : ENSTA.
This contract is about the scattering of elastic waves by a local defects in an anisotropic plate. It consists on
the funding of Antoine Tonnoir's Phd.

7.4. Contract POEMS-DGA

Participants: Anne-Sophie Bonnet-Ben Dhia, Bérangère Delourme, Sonia Fliss, Patrick Joly.

Start : 09/01/2011, End : 12/31/2013. Administrator : ENSTA.
This contract is about the waveguide in photonic crystals : we want to develop new mathematical and numerical
tools for the characterization, the study and the computation of the guided modes in photonic crystals.

SCIPORT Team (section vide)

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

7. Bilateral Contracts and Grants with Industry

7.1. Numerical homogenization for models of transfer of solutes in porous media

Participants: Antoine Gloria, Zakaria Habibi.

This is a contract (2011-2012) between Inria and ANDRA. The aim of this research is to determine the effective coefficients for models of transfer of solutes in porous media. This is a numerical homogenization problem for a coupled system of convection-diffusion equations. This enters the framework of the numerical simulation for radioactive waste disposal devices.

7.2. Study of the EKINOX model of corrosion

Participants: Claire Chainais, Antoine Gloria.

This is a CNRS Contract (2012-2013) with CEA, Univ Lille1, and Univ B. Pascal. In collaboration with C.Desgranges and F. Lequien (CEA), F. Bouchon (Univ. B. Pascal), A. Gloria and C. Chainais-Hillairet are considering the model EKINOX developed at CEA for the study of the corrosion of Ni-base alloys in PWR primary water. Starting from this numerical model (leading to an explicit in time scheme), they have established a macroscopic model (a system of coupled partial differential equations). Based on this model, the aim is to propose some new numerical methods taking into account correctly the relevant time scales or scales of parameters.

7.3. Numerical methods for the DPCM model

Participants: Claire Chainais, Thomas Gallouët, Antoine Gloria.

This is a contract (2012-2014) between Inria and ANDRA. Some numerical methods have already been developed for the approximation of the DPCM model (corrosion model of an iron based alloy in the nuclear waste repository), see [4]. These methods have been implemented in the code CALIPSO developed at ANDRA. They are devoted to the simulation of the time-dependent model and based on a implicit first order in time and second order in space scheme. For this problem, we want to develop second order in time schemes which remain unconditionally stable. We also want to design new schemes for the direct computation of a steady-state. This should be done during the post-doc of Thomas Gallouët. This is work in collaboration with C. Bataillon (CEA), F. Bouchon (Univ B. Pascal) and J. Fuhrmann (WIAS Berlin).

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

7. Bilateral Contracts and Grants with Industry

7.1. Contract CNES-Inria-Xlim

Contract (reference Inria: 7066, CNES: 127 197/00) involving CNES, XLim and Inria, focuses on the development of synthesis procedures for N-ports microwave devices. The objective is here to derive analytical procedures for the design of multiplexers and routers as opposed to the classical "black box optimization" which is usually employed in this field (for $N \geq 3$).

7.2. Contract CNES-Inria-UPV/EHU

Contract (reference CNES: RS10/TG-0001-019) involving CNES, University of Bilbao (UPV/EHU) and Inria whose objective is to set up a methodology for testing the stability of amplifying devices. The work at Inria concerns the design of frequency optimization techniques to identify the linearized response and analyze the linear periodic components.

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

7. Bilateral Contracts and Grants with Industry

7.1. CIFRE THESIS

7.1.1. *Schneider Electric*

Participants: Vincent Acary, Narendra Akadkhar, Bernard Brogliato.

This is a long-term relationship with this company, starting in 2001 with the post-doc of V. Acary. A PhD thesis funded by SE started in December 2012 (Narendra Akadkhar), co-supervised by V. Acary and B. Brogliato, and by M. Abadie (SE). The topic is about simulation of circuit breakers with mechanical play, and multiple impacts with friction modelling.

7.1.2. *ANSYS*

Participants: Vincent Acary, Mounia Haddouni, Bernard Brogliato.

This collaboration started in May 2012 with the CIFRE thesis of M. Haddouni. The topic is about numerical simulation of multibody systems with unilateral contact, impacts and friction.

7.1.3. *ALDEBARAN*

Participants: Pierre-Brice Wieber, Jory Lafaye.

This collaboration started in March 2012 with the CIFRE thesis of J. Lafaye. The topic is biped walking control schemes in dynamic environments.

7.1.4. *ADEPT*

Participants: Pierre-Brice Wieber, Saed Al Homsi.

This collaboration started in September 2012 with the CIFRE thesis of S. Al Homsi. The topic is fast reactive motion generation for manipulator robots.

7.2. Other contracts

7.2.1. *L'OREAL*

Participant: Florence Bertails-Descoubes.

L'OREAL: Contrat d'étude with L'Oréal, starting in December 2012 until April 2013 .

<p align="center">**COMMANDS Project-Team**</p>

7. Bilateral Contracts and Grants with Industry

7.1. Renault

Participants: Frédéric Bonnans, Giovanni Granato, Hasnaa Zidani.

This contract has supported the PhD thesis of Giovanni Granato. The purpose of this collaboration is to apply optimal control techniques to enhance the performance of the power management of hybrid vehicles. More precisely, the techniques concerned are viscosity solutions of Hamilton-Jacobi (HJ) equations, level set methods in reachability analysis, stochastic dynamic programming (SDP), stochastic dual dynamic programming (SDDP) and chance constrained optimal control. These are relatively sophisticated optimal control techniques, presenting a rupture (from the application point of view) of more classical techniques (e.g. dynamic programming, maximum principle and heuristic algorithms) found in the literature. The outcome of the PhD work is to assess the general interest in applying such techniques to the power management of hybrid vehicles. This includes stating the relevant modeling choices, implementing a research-level code of the algorithms for simulations and providing a proper interpretation of the simulations results.

The research undertaken in this contract have lead to four submitted patents (Renault-Inria), a numerical platform for simulations of the studied technics, 1 accepted conference paper (CDC), 2 submitted papers in peer-reviewed journals, and 2 preprints in preparation.

7.2. Astrium-Eads

Participant: Hasnaa Zidani.

This collaboration aims at analysing the sensitivity properties of a trajectory optimisation problem under probabilistic constraints (on modelling errors, component failure, ...etc). This includes a modeling of the problem, and implementation of efficient algorithms supportting the theoretical study. The collaboration started in 2012 and will last three years.

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

7. Bilateral Contracts and Grants with Industry

7.1. FRAE (Fondation de Recherche pour l'Aéronautique et l'Espace)

In March 2010, Karim Ramdani obtained a 2 years funding from FRAE [3] to work on inverse problems in Aeronautics. The project involves two partners : Inria Nancy Grand-Est (7 participants, from which 5 members of CORIDA) and ONERA Toulouse (4 participants).

7.2. EADS Foundation

We obtained a four years grant (2010-2014) of 147000 euros from EADS foundation. This project aims to develop new efficient numerical methods to solve electromagnetic scattering problems. Part of this grant is used to support the Phd of I. Zangré supervised by X. Antoine and C. Geuzaine (University of Liège). Y. Saad (university of Minneapolis) is also involved in this project.

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[3]Fondation de Recherche pour l'Aéronautique et l'Espace : http://www.fnrae.org/

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

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

As a part of his research actions in the Control Department of Supélec, Guillaume Sandou has numerous collaborations with Industry (Renault, Astrium, Sagem, Valeo). This may lead to relevant opportunities for the DISCO project.

Guillaume Sandou is in particular the head of the RISEGrid Institute (Resaerch Institut for Smarter Electric Grids), joint institute between Supelec and EDF R&D.

GECO Team (section vide)

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

7. Bilateral Contracts and Grants with Industry

7.1. Contrats avec l'Industrie/Bilateral Contracts with Industry

- Optimisation de services en ligne: CRE avec Orange Labs (responsable du suivi Orange Labs: Mustapha Bouhtou), de février 2009 à février 2012, portant sur l'application de l'optimisation à la tarification et à l'amélioration de services en ligne. Ce travail applique des techiques d'optimisation (processus de décision markoviens) et d'analyse non-linéaire (généralisations d'algorithmes de classement de type "pagerank") dans un but notamment d'amélioration du référencement, et étudie les problèmes de tarification reliés. Ce contrat a financé la thèse d'Olivier Fercoq, soutenue en Septembre 2012.

- Thèse CIFRE de J-B. Dumont, financée par Orange Labs (encadrant Orange Labs: Mustapha Bouhtou, directeur de thèse: S. Gaubert), démarrée en septembre 2010. Sujet: tarification de services data et gestion des ressources dans les réseaux mobiles 3G et LTE.

MCTAO Team

6. Bilateral Contracts and Grants with Industry

6.1. Thales Alenia Space - Inria

"Transfert orbital dans le problème des deux et trois corps avec la technique de propulsion faible".

This contract starts October, 2012 for 3 years. It partially supports Helen Heninger's PhD.

The goal is to improve transfer strategies for guidance of a spacecraft in the gravitation field of one central body (the two-body problem) or two celestial bodies (three-body problem).

6.2. CNES - Inria - UPV/EHU

Contract (reference CNES: RS10/TG-0001-019) ending May, 2013. It involves CNES, University of Bilbao (UPV/EHU) and Inria; its objective is to set up a methodology for testing the stability of nonlinear amplifying devices via frequency optimization techniques.

On the Inria side, this contract concerns McTAO for 25% and APICS project-team for 75%.

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

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. KARRUS start-up

The NeCS team is continuing its activity in road traffic modeling and control. The expected scientific contribution of NeCS in this field concerns the development of new estimation prediction and identification algorithms based on the measurements collected through sensor networks installed on freeways. The team study also the problems of time-to destination and control algorithms for ramp metering. The team is currently setting up a consortium with local authorities involved in traffic management to build a demonstrator called GTL for Grenoble Traffic Lab. One target of this activity is to transfer part of the developed technology to a start-up named Karrus and led by Denis Jacquet (http://www.karrus.fr/). The start-up was created in January 2010.

7.2. Bilateral Grants with Industry

7.2.1. AIRBUS

Accompanying PhD contract with AIRBUS in the framework of the CIFRE PhD grant of P. Andrianiaina. The goal of this PhD thesis is to study flexible implementation methods for real-time controllers, aimed at reducing the conservatism induced by the current approach purely based on worst case considerations.

7.2.2. IFPEN

Accompanying PhD contract with IFPEN (IFP Energies Nouvelles), in the framework of the PhD grant of A. Ben Khaled. The thesis explores new architectures and flexible scheduling methods to enhance the trade-off between the integration accuracy and the simulation speed of distributed real-time (hardware-in-the-loop) simulators, in particular in the framework of automotive power-trains.

Accompanying PhD contract with IFPEN (IFP Energies Nouvelles), in the framework of the PhD grant of Giovanni de Nunzio. The thesis explores eco-driving for comunicating vehicles in urban environment.

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

6. Bilateral Contracts and Grants with Industry

6.1. Projects

- Project SYSIASS http://www.sysiass.eu/;
  - Subject: Autonomous and Intelligent Healthcare System;
  - Partners: ISEN de Lille, Ecole Centrale de Lille, University of Kent, University of Essex, East Kent Hospitals University NHS Foundation Trust, Groupement Hospitalier de l'Institut Catholique de Lille;
  - Duration: 2010 - 2013;
  - Support: FEDER;
- Project CHASLIM http://chaslim.gforge.inria.fr/;
  - Subject: Sliding mode control;
  - Partners: Inria Grenoble-Rhône Alpes, Inria Lille-Nord Europe, Ecole Centrale de Nantes;
  - Duration: 2011-2014;
  - Support: ANR;
- Project HYCON2 http://www.hycon2.eu/;
  - Subject: Networked control systems;
  - Partners: See http://www.hycon2.eu/?page=5&PHPSESSID=c185e278a6cab0a35c8dea0970c5723d
  - Duration: 2010-2015;
  - Support: FP7;
- Project SENSAS http://sensas.gforge.inria.fr/wiki/doku.php;
  - Subject: Sensor network Applications;
  - Partners: Inria Grenoble-Rhône Alpes, Inria Lille-Nord Europe, Inria Sophia Antipolis-Méditerranée, Inria Nancy-Grand Est;
  - Duration: 2010-2014;
  - Support: ANR;
- Project SLIM
  - Subject: Software library for multi-robots cooperation;
  - Duration: 2012-2014;
  - Support: Inria ADT;
- Project FP7 ERRICS http://cordis.europa.eu/projects/index.cfm?fuseaction=app.details&TXT=ERRIC&FRM=1&STP=10
  - Subject: ERRIC-Empowering Romanian Research on Intelligent Information Technologies;
  - Partners: UNIVERSITATEA POLITEHNICA DIN BUCURESTI;
  - Duration: 2010-2013;
  - Support: EU FP7 Capacities Programme.

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

6. Bilateral Contracts and Grants with Industry

6.1. Students Paid by Industrial Partners / Contracts with Industry

- Gérard Biau finished supervising the PhD thesis of Benoît Patra, which took place till March 2012 within an industrial contract ("thèse CIFRE") with Lokad.com (http://www.lokad.com/).

- Gérard Biau has been supervising the PhD thesis of Baptiste Gregorutti since December 2011, within an industrial contract ("thèse CIFRE") with Safety Line (http://www.safety-line.fr/index.php/fr/)

- Gilles Stoltz has been supervising the PhD thesis of Pierre Gaillard, which takes place since September 2012 within an industrial contract ("thèse CIFRE") with EDF R&D (http://innovation.edf.com/).

- Gilles Stoltz supervised the M.Sc. internship of Charles-Pierre Astolfi, which took place within a collaboration with IFP Energies nouvelles (http://www.ifpenergiesnouvelles.fr/).

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

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- EDF (2011-2013): Bilevel mathematical programming and pricing problems.
- EDF (2011-2014): Scheduluing outages of nuclear plants.
- Tasker (2011-2014) : Scheduling of applications in hybrid cloud computing systems.
- Alicante (2010-2013): PhD of Julie Jacques. Knowledge extraction by optimization methods for improving the process of inclusion in clinical trials.
- Genes Diffusion (2010-2013): PhD of Julie Hamon. Analysis of data from high throughput genotyping: cooperation between statistics and combinatorial optimization.
- Strat&Logic (2012-2015): PhD of Sylvain Dufourny. Optimization of economic decisions in a competitive business management simulator.
- Vekia (2012-2015). The goal of the project is to develop an efficient and generic software for employee scheduling in retail.
- BTravel (2011-2015). This project deals with the optimization of group travel plannings.
- NewCo (2011-2012) : Optimisation of client programs in the tourism industry.

GEOSTAT Project-Team (section vide)

MISTIS Project-Team (section vide)

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

7. Bilateral Contracts and Grants with Industry

7.1. Arcelor-Mittal

Participants: Christophe Biernacki, Clément Thery.

Subject : *Supervised and semi-supervised classification on large data bases mixing qualitative and quantitative variables.*

Arcelor Mittal faced some quality problems in the steel production which lead to supervised and semi-supervised classification involving (1) a small number of individuals comparing to the numbers of variables, (2) heterogeneous variables, typically categorical and continous variables and (3) potentially highly correlated variables. A PhD CIFRE grant started on May 2011 on this topic.

7.2. Gene Diffusion

Participants: Julien Jacques, Julie Hamon.

Subject : *Data analysis from high throughput technologies: Synergy between statistics and combinatorial optimization.*

With the development of new technologies such as high-throughput genotyping and sequencing, data analysis needs to be improved. Genes Diffusion is specialized in animals studies, for which we can read genomics information on around 800 000 markers and we have more and more subjects. The aim of the PhD is to find new methods combining combinatorial optimization and statistics methods in order to characterize the best subjects according to quantitative criteria. A PhD CIFRE grant started on 2010 and it is a joined work with Clarisse Dhaenens (Inria/DOLPHIN).

7.3. ASEL & CRESGE

Participants: Cristian Preda, Michael Genin.

Subject : *Incidence of lymphoms in Nord-Pas-de-Calais, Annual Estimates and study of the evolution over the period 2001-2005.* It is a contract with ASEL (Association Septentrionale pour l'Etude de Lymphomes) and CRESGE (Centre de Recherches Economiques Sociologiques et de Gestion) from Lille. This project of 6000 euros started on September 1st 2012 and ends on Mai 1st 2013.

REALOPT Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contract with EDF on maintenance planning

We are currently working on a project aiming to plan the energy production and the maintenance breaks for a set of nuclear power plants generating electricity. This problem has two different levels of decisions. The first one consist in determining, for a certain time horizon, when the different power plants will have to stop in order to perform maintenance and to decide the amount of fuel to be reloaded. The second decision level aims to decide the quantity of power each plant will have to produce for each probabilistic scenario on the energy consumption and the duration of maintenance. The model that we are considering combines issues of stochastic optimization (to handle demand scenarios), robust optimization (to account for variation in maintenance duration), and dynamic optimization (the maintenance of nuclear plants are programmed on a five year horizon, but the long term planning is review each month for adjustments due to perturbations.

This project is carried in collaboration between EDF R&D (OSIRIS lab) Inria team Dolphin and Realopt. The research is the subject of the PhD thesis of Nicolas Dupin (DGA).

<div align="center">

SELECT Project-Team

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7. Bilateral Contracts and Grants with Industry

7.1. Contracts with EDF

Participants: Gilles Celeux, Jean-Michel Poggi.

- SELECT has a contract with EDF regarding modelling uncertainty in deterministic models.
- SELECT has a contract with EDF regarding wavelet analysis of the electrical load consumption for the aggregation and desaggregation of curves to improve total signal prediction.

7.2. Other contracts

Participants: Gilles Celeux, Rémy Fouchereau, Patrick Pamphile.

- SELECT has a contract with SAFRAN - SNECMA, an high-technology group (Aerospace propulsion, Aicraft equipment, Defense Security, Communications),regarding modelling reliability of Aircraft Equipment (collaboration with Patrick Pamphile (Université Paris-Sud).

<div align="center">

SEQUEL Project-Team

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7. Bilateral Contracts and Grants with Industry

7.1. Orange Labs

Participant: Jérémie Mary.

There has been various activities between SEQUEL and Orange Labs.

First, the collaboration around the PhD of Christophe Salperwyck has continued and eventually led to his defense. Second, a CRE has been signed in 2011 to continue our work on web advertising, and more generally, collaborative filtering. On this topic, Sami Naamane has been hired in Fall 2011 as PhD student.

7.2. Effigenie

Participant: Jérémie Mary.

We are currently working on better prediction of news websites audiences in order to plan some better strategies for marketing services. A prediction module should be produced in 2013.

7.3. Squoring Technology

Participants: Boris Baldassari, Philippe Preux.

Boris Baldassari has been hired by Squoring Technology (Toulouse) as a PhD student in May 2011. He works on the use of machine learning to improve the quality of the software development process. During his first year as a PhD student, Boris investigated the existing norms and measures of quality of software development process. He also dedicated some times to gather some relevant datasets, which are made of either the sequence of source code releases over a multi-years period, or all the versions stored on an svn repository (svn or alike). Information from mailing-lists (bugs, support, ...) may also be part of these datasets. Tools in machine learning capable of dealing with this sort of data have also been investigated. Goals that may be reached in this endeavor have also been precised.

7.4. TBS

Participants: Jérémie Mary, Philippe Preux.

A new project has started on September 2012 in collaboration with the TBS company. The goal is to understand and predict the audiences of some news related websites. These websites tend to present an ergodic frequentation with respect to a context. The main goal is to separate the effect of the context (big events, election, ...) and the impact of the policies of the news websites. This research is done using data from major french media websites and also involves research of tendances on the web (like Google Trends/ Google Flu). Used algorithms mix methods from time series prediction (ARIMA and MARSS models) and some machine learning methods (L1 penalization, SVM).

7.5. Unbalance Corporation

Participant: Rémi Coulom.

Unbalance Corporation (http://www.unbalance.co.jp/) is a Japanese publisher of game software. We have two license agreements with this company, for the games of Go and Hanafuda.

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

Participant: Francis Bach.

Google Research Award: "Large scale adaptive machine learning with finite data sets".

<p align="center">TAO Project-Team</p>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- The ILAB *Metis* is a close partnership with the **SME ARTELYS** whose aim is to develop a generic optimisation platform for sequential decision making that could be used for different applications. See Section 5.1 for a detailed description.

7.2. Bilateral Grants with Industry

- **PSA** – 2009-2012 (45 kEur). , side-contract to Mouadh Yagoubi's CIFRE Ph.D.;
  Participants: Marc Schoenauer, Mouadh Yagoubi.

- **THALES** – 2011-2014 (40 kEur). , side-contract to Gaetan Marceau-Caron's CIFRE Ph.D.;
  Participants: Marc Schoenauer, Gaetan Marceau-Caron.

- **EXQIM** – 2011-2014 (40 kEur). , side-contract to Moez Hammami's CIFRE Ph.D.;
  Participants: Michèle Sebag, Moez Hammami.

ALEA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Contract with CEA CESTA. The aim of this contract is to develop several extensions to the software BiiPS and to provide a Bayesian statistical modelling on various problems of interest to CEA.

Contract with Astrium/EADS. The aim of this contract, in collaboration with the EPI AYIN, is to develop automatic object tracking algorithms on a sequence of images taken from a geostationary satellite. P. Del Moral cosupervises with J. Zerubia the PhD thesis of Paula Craciun on this subject.

Contract with Dassault. The aim of this contract, in collaboration with the EPI I4S is to address calibration problems using interacting Kalman filters.

ASPI Project-Team (section vide)

CQFD Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Astrium

Participants: Romain Azaïs, Adrien Brandejsky, Benoîte de Saporta, François Dufour, Anne Gégout-Petit, Huilong Zhang.

The goal of this project is to propose models for fatigue of structure and to study an approach to evaluate the probability of occurrence of events defined by the crossing of a threshold. In this context, Astrium funded the PhD Thesis of Adrien Brandejsky (2009-2012) and is a partner of ANR Fautocoes.

6.2. DCNS

Participants: Benoîte de Saporta, François Dufour, Huilong Zhang.

In september 2010, an industrial collaboration started with DCNS on the application of Markov Decision Processes to optimal stochastic control of a submarine to maximize the acoustic signature of a target vessel. In 2012, we extended our previous results to multiple target vessels and 3D control. We also coupled our code with the output of a tracking software to take more realistically into account the uncertainty on the position and speed of the targets. This work gave rise to a new technical report [54] and a presentation in an international conference [35].

6.3. EDF Approdyn

Participants: Benoîte de Saporta, François Dufour, Huilong Zhang.

The objective of this project is develop new methodologies for studying the dynamic reliability of controlled systems used in the critical area of power generation and process industries. We work on a benchmark of steam generator with four physical processes: feedwater flowrate , steam flow, narrow range water level and wide range water level. A PID controller is used to maintain the water level within limits of set-points. The system is composed of seven components: 1 passive system representing vapor transport system, 3 extraction pumps, 2 feeding turbopumps, and 1 waterflow regulation valve. We also take into account captors and their possible failures. This work gave rise to a technical report [53] and was presented in an international conference [36], a national conference [39] and is published as a book chapter [49].

6.4. Thales Optronique

Participants: Camille Baysse, Benoîte de Saporta, François Dufour, Anne Gégout-Petit, Jérôme Saracco.

Integrated maintenance, failure intensity, optimisation.

The goal of the project is the optimization of the maintenance of a on board system with a HUMS (Health Unit Monitoring Systems). The collaboration is the subject of the PhD of Camille Baysse (CIFRE) on this problem. This work gave rise to a technical report, was presented in an international conference [30], a national conference [38] and is submitted for publication

6.5. LyRE

Participant: Jérôme Saracco.

The goal of this contract with the LyRE ((R & D research center of Lyonnaise des Eaux)) is to provide management and consultancy tools to keep the immense heritage of these drinking water and sanitation distribution networks in optimal condition. A PhD student (K. Claudio) of J. Saracco is working in the LyRE team on sampling problems coming from a partial automatic teletransmission of water consumption data. This works has been presented at the "7ème colloque francophone sur les sondages" on November 2012 at ENSAI, Rennes.The lecture is untilted "Estimation de la consommation d'eau d'un secteur à partir d'un échantillon d'usagers télérelevés".

A patent describing the statistical methodology has also been registered in Novembrer 2012.

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. Contracts with SVS

Participants: Laurent Mevel, Michael Döhler.

Annual agreement Inria-SVS 2381 + contract 4329

I4S is doing technology transfer towards SVS to implement I4S technologies into ARTEMIS Extractor Pro. This is done under a royalty agreement between Inria and SVS .

7.2. Bilateral Grants with Industry

7.2.1. PhD CIFRE with Dassault Aviation

Participants: Laurent Mevel, Philippe Mellinger.

Following the FliTE2 project, a joint PhD thesis between Inria and Dassault Aviation has been initiated. The thesis will pursue the work achieved in FliTE2 and started in June 2011 funded by Dassault Aviation and the CIFRE Agency.

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

PREMIA consortium, presently composed of Crédit Agricole CIB, Société Générale, Natixis, and Pricing Partners.

<p align="center">**REGULARITY Project-Team**</p>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

CSDL (Complex Systems Design Lab) project of the Pôle de Compétitivité SYSTEM@TIC PARIS-REGION (11/2009-10/2012). The goal of the project is the development of a scientific plateform of decisional visualization for preliminary design of complex system. Industrial partners include Dassault Aviation, EADS, EDF, MBDA and Renault. Academic partners include ECP, Ecole des Mines de Paris, ENS Cachan, Inria ands Supelec.

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

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- TOSCA Nancy had a bilateral contract with the SME Alphability on the evaluation of the Value at Risk with applications in portfolio management. This collaboration will be continued in 2013.