



RESEARCH CENTER  
Bordeaux - Sud-Ouest

FIELD

Activity Report 2012

# Section Contracts and Grants with Industry

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## **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.

## **BACCHUS Team**

# **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.

**CAGIRE Team (section vide)**

**CARMEN Team (section vide)**

**CEPAGE Project-Team (section vide)**



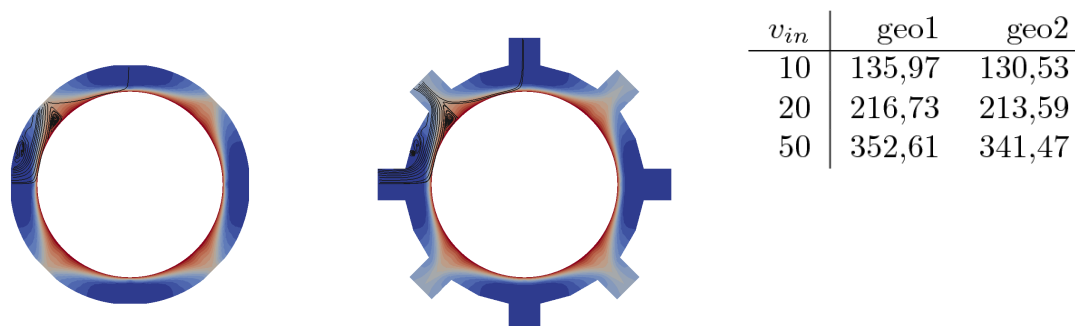
## CONCHA Project-Team

# 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.



*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.

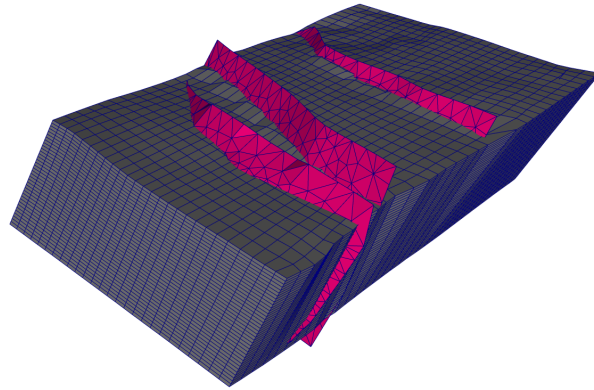
Among the different questions concerning modeling such as the boundary conditions at the in- and outlets and the sensitivity to the geometry, a particular point of interest is the study of compressibility effects.

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.

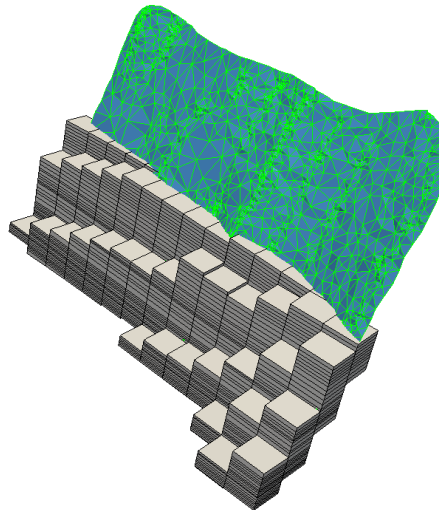
## 7.2. Fractured reservoir (Total)

**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 Puisieux from LMA.



*Figure 16. Fractured reservoir*



*Figure 17. Intersection between fault and reservoir*

## 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 Fautocoos.

## 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 untitled “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 November 2012.

## FLOWERS Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Bilateral Grants with Industry

### 7.1.1. *Fondation Cartier pour l'Art Contemporain*

The team has been collaborating with Fondation Cartier pour l'Art Contemporain in the context of the elaboration of the exhibition "Mathematical: A Beautiful Elsewhere" (<http://fondation.cartier.com>), to be held from October 2011 to March 2012, as well as with artist David Lynch, to build the robotic installation/experiment Ergo-Robots/FLOWERS Fields. This robotic installation illustrates, as well as allows to experiment in a realistic setup on the long term, computational models of curiosity-driven learning, human-robot interaction and language formation. Fondation Cartier participated to the funding of this experiment/installation. A dedicated web page is available at: <http://flowers.inria.fr/ergo-robots.php>

### 7.1.2. *Honda Research Institute USA Inc.*

Alexander Geppert is collaborating with Honda Research Institute USA Inc. to implement and evaluate a real-time pedestrian detection and pose classification system with the goal of creating an industrial product in the coming years. Particular aspects of the project are robustness and real-time capability. Robustness is approached by the use of state-of-the-art image feature representations, a sophisticated hierarchy of linear and non-linear support vector classifiers, and dedicated tracking algorithms. Real-time capability is ensured by running the time-critical parts of the whole-image search on a GPU. A particular focus of the project is the use of synthetically rendered pedestrian images for detector training, which ameliorates the problem of insufficient training data. This work has been submitted to the "International Conference On Computer Vision and Pattern Recognition" (CVPR) as well as the "Intelligent Vehicles Symposium" (IV). Honda Research Institute USA Inc. support Alexander Geppert by financing a post-doctoral researcher at ENSTA ParisTech during one year, grant volume: 50.000USD.

### 7.1.3. *Robert Kostal GmbH*

Alexander Geppert has collaborated with Robert Kostal GmbH, Dortmund (Germany) on the subject of real-time pose recognition from 3D camera data. This project was conducted mainly through an internship student financed by Robert Kostal GmbH.

### 7.1.4. *Honda Research Institute Europe GmbH*

Alexander Geppert and Louis-Charles Caron have collaborated with Honda Research Institute Europe GmbH, Offenbach (Germany) on the subject of real-time shape recognition for robotics. This project was conducted through an internship student financed by Honda Research Institute Europe GmbH, and through the visit of Louis-Charles Caron to Honda Research Institute Europe GmbH in summer 2012.

### 7.1.5. *Pal Robotics*

Freek Stulp is continuing his collaboration with Pal Robotics in Barcelona to implement and evaluate the use of Dynamic Motion Primitives on the commercial mobile platform 'REEM'. A particular focus of this project is to compare the respective advantages of motion primitives and sampling-based motion planning approaches in the context of human-robot interaction. Pal Robotics is supporting Freek Stulp by co-financing travel costs for regular project meetings in Barcelona: <http://www.pal-robotics.com/blog/freek-stulp-visited-pal-robotics/>. In 2012 this collaboration has lead to a paper at Humanoids [45], and a video at IROS, which was selected for an interactive session, "in consideration of the quality of your work".

**GEOSTAT Project-Team (section vide)**

## **HIEPACS Project-Team**

# **7. Bilateral Contracts and Grants with Industry**

## **7.1. Bilateral Contracts with Industry**

ASTRIUM Space Transportation research and development contract:

- Design of a parallel version of the FLUSEPA software (Jean-Marie Couteyen (Intership); Jean Roman).

CEA Cadarache (ITER) research and development contract:

- Peta and exaflop algorithms for turbulence simulations of fusion plasmas (Fabien Rozar (PhD); Guillaume Latu, Jean Roman).

EDF R & D - SINETICS research and development contract:

- Design of a massively parallel version of the SN method for neutronic simulations (Moustapha Salli (PhD); Pierre Ramet, Jean Roman).

TOTAL research and development contracts:

- Parallel hybrid solver for massively heterogeneous manycore platforms (Stojce Nakov (PhD); Emmanuel Agullo, Luc Giraud, Abdou Guermouche, Jean Roman).
- Parallel elastodynamic solver for 3D models with local mesh refinement (Yohann Dudouit (PhD); Luc Giraud and Sébastien Pernet from ALGO-EMA at CERFACS).

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## LFANT Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Industrial ANR PACE

**Participants:** Andreas Enge, Jérôme Milan.

<https://pace.rd.francetelecom.com/>

The PACE project unites researchers of France Télécom, Gemalto, NXP, Cryptolog International, the INRIA project teams CASCADE and LFANT and University of Caen. It deals with electronic commerce and more precisely with electronic cash systems. Electronic cash refers to money exchanged electronically, with the aim of emulating paper money and its traditional properties and use cases, such as the anonymity of users during spending. The goal of PACE is to use the new and powerful tool of bilinear pairings on algebraic curves to solve remaining open problems in electronic cash, such as the strong unforgeability of money and the strong unlinkability of transactions, which would allow users to conveniently be anonymous and untraceable. It also studies some cryptographic tools that are useful in the design of e-cash systems.

## 7.2. DGA

Contract with *DGA maîtrise de l'information* about number theory and cryptography

- Duration: two years, 2011–2013
- Scientific coordinator: J.-M. Couveignes
- Topics covered: index calculus and discrete logarithms, fast arithmetic for polynomials, pairings and cryptography, algorithmics of the Langlands programme

## 7.3. Thèse cifre

**Participants:** Karim Belabas, Vincent Verneuil.

Vincent Verneuil, co-directed with B. Feix (Inside Contactless) and C. Clavier (Université de Limoges), works at Inside Contactless on elliptic curve cryptography, with an emphasis on embedded systems and side-channel attacks.

## **MAGIQUE-3D Project-Team**

# **7. Bilateral Contracts and Grants with Industry**

## **7.1. Contracts with TOTAL**

- Depth Imaging Partnership (DIP)  
Period: 2010 January - 2012 december, Management: Inria Bordeaux Sud-Ouest, Amount: 3600000 euros. 150 000 euros have been devoted to hire an associate engineer (from Oct. 2010 to Sept. 2012).
- Schémas en temps d'ordre élevé pour la simulation d'ondes élastiques en milieux fortement hétérogènes par des méthodes DG.  
Period: 2010 November - 2013 October, Management: Inria Bordeaux Sud-Ouest, Amount: 150000 euros.
- Propagateurs optimisés pour les ondes élastiques en milieux anisotropes  
Period: 2010 November - 2014 October, Management: Inria Bordeaux Sud-Ouest, Amount: 160000 euros.
- RTM en milieux hétérogènes par équations d'ondes élastiques  
Period: 2011 November - 2014 October, Management: Inria Bordeaux Sud-Ouest, Amount: 160000 euros.



## MAGNOME Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Contracts with Industry

SARCO, the research subsidiary of the Laffort group, has entered into a contract with MAGNOME to develop comparative genomics tools for selecting wine starters. This contract will permit SARCO to take a decisive step in the understanding of oenological microorganisms by obtaining and exploiting the sequences of their genomes. Comparison of the genomes of these strains has become absolutely necessary for learning the genetic origin of the phenotypic variations of oenological yeasts and bacteria. This knowledge will permit SARCO to optimize and accelerate the process of selection of the highest-performing natural strains. With the help of MAGNOME members and their rich experience in comparative analysis of related genomes, SARCO will acquire competence in biological analysis of genomic sequences. At the same time, MAGNOME members will acquire further experience with the genomes of winemaking microorganisms, which will help us define new tools and methods better adapted to this kind of industrial cell factory.

## 7.2. Grants with Industry

The French Petroleum Institute (*Institut français de pétrole-énergies nouvelles*) is coordinating a 6 M-Euro contract with the Civil Aviation Directorate (*Direction Générale de l'Aviation Civile*) on behalf of a large consortium of industrial (EADS, Dassault, Snecma, Turbomeca, Airbus, Air France, Total) and academic (CNRS, INRA, Inria) partners to explore different technologies for alternative fuels for aviation. The CAER project studies both biofuel products and production, improved jet engine design, and the impact of aircraft. Within CAER MAGNOME via CNRS, works with partners from Grignon and Toulouse on the genomics of highly-performant oleaginous yeasts.

**MANAO Team (section vide)**

## MC2 Project-Team

# 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)

**MNEMOSYNE Team (section vide)**

## PHOENIX Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Bilateral Grants with Industry

### 7.1.1. Integrating non-functional properties in a Design Language and its execution environment – Industrial Fellowship (CIFRE / Thales)

**Participants:** Charles Consel, Emilie Balland, Stéphanie Gatti, Quentin Enard.

The goal of this project is to add non-functional properties in the DIASPEC language and in the DIAGEN generator. More especially, these non-functional properties are considered on three different levels:

- *The component level.* The non-functional properties define temporal, physical and software constraints restrictive for a component.
- *The component coupling level.* The non-functional properties define the dependency between the components as well as the Quality of Service provided and required by each component of the environment.
- *The software architecture level.* The non-functional properties describe the resources that must be allocated to a component (memory, processing capacity). They also define the necessary resources for a component to interact with other components (network QoS).

This work will be illustrated and validated with a concrete application in the avionics domain.

**POTIOC Team (section vide)**

## **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).

## **RUNTIME Project-Team**

# **7. Bilateral Contracts and Grants with Industry**

## **7.1. Bilateral Contracts with Industry**

SAMSUNG We have signed a contract with the Samsung company to work on the *Generation of Parallel Patterns based programs for hybrid CPU-GPU architectures* from october 2012 to september 2013.

## **7.2. Bilateral Grants with Industry**

STMicroelectronics STMicroelectronics is granting the CIFRE PhD Thesis of Paul-Antoine Arras on *The development of a flexible heterogeneous system-on-chip platform using a mix of programmable processing elements and hardware accelerators* from October 2011 to October 2014.

TOTAL TOTAL is granting the CIFRE PhD thesis of Corentin Rossignon on *Sparse GMRES on heterogeneous platforms in oil extraction simulation* from april 2012 to march 2015.

CEA-CESTA CEA-CESTA is granting the CIFRE PhD thesis of Cyril Bordage on *Parallelization of fast multipole methods over hybrid CPU+GPU architectures* from october 2009 to november 2012.