



RESEARCH CENTER  
Bordeaux - Sud-Ouest

FIELD

Activity Report 2014

# Section Contracts and Grants with Industry

Edition: 2015-03-24



ALGORITHMICS, PROGRAMMING, SOFTWARE AND ARCHITECTURE	
1. LFANT Project-Team (section vide) .....	4
APPLIED MATHEMATICS, COMPUTATION AND SIMULATION	
2. BACCHUS Team (section vide) .....	5
3. CAGIRE Team .....	6
4. CQFD Project-Team .....	7
5. GEOSTAT Project-Team (section vide) .....	8
6. MC2 Team .....	9
7. REALOPT Project-Team .....	10
DIGITAL HEALTH, BIOLOGY AND EARTH	
8. CARMEN Team (section vide) .....	12
9. MAGIQUE-3D Project-Team .....	13
10. MAGNOME Project-Team .....	14
11. MNEMOSYNE Project-Team (section vide) .....	15
12. SISTM Team .....	16
NETWORKS, SYSTEMS AND SERVICES, DISTRIBUTED COMPUTING	
13. HIEPACS Project-Team .....	17
14. PHOENIX Project-Team (section vide) .....	18
15. RUNTIME Team .....	19
PERCEPTION, COGNITION AND INTERACTION	
16. FLOWERS Project-Team .....	20
17. MANAO Project-Team .....	21
18. POTIOC Project-Team .....	22

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

**BACCHUS Team (section vide)**

## **CAGIRE Team**

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

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

Collaborative research contract with EDF: “Nouveau modèle de turbulence Haut-Bas Reynolds avec prise en compte de la thermique active ou passive. (New high-low Reynolds number turbulence model accounting for active or passive heat transfer)” associated with the PhD thesis of J.-F. Wald.

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

PhD grant (CIFRE) of J.-F. Wald, EDF, in progress.

## CQFD Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Airbus

**Participants:** Benoîte de Saporta, François Dufour, Christophe Nivot.

We are interested in the optimization of a launcher integration process. It comprises several steps from the production of the subassemblies to the final launch. The four subassemblies go through various types of operations such as preparation, integration, control and storage. These operations are split up into three workshops. Due to possible breakdowns or staff issues, the time spent in each workshop is supposed random. So is the time needed to deliver the subassemblies, for similar reasons including e.g. shipping delays. We also have to deal with constraints related to the architecture of the assembly process itself. Indeed, we have to take into account waiting policies between workshops. The workshops may work in parallel but can be blocked if their output is not transferred to the next workshop in line. Storage capacity of output products is limited.

Our goal is finding the best rates of delivery of the subassemblies, the best choice of architecture (regarding stock capacities) and the best times when to stop and restart the workshops to be able to carry out twelve launches a year according to a predetermined schedule at minimal cost. To solve this problem, we choose a mathematical model particularly suitable for optimization with randomness: Markov decision processes (MDPs).

We have implemented a numerical simulator of the process based on the MDP model. It provides the fullest information possible on the process at any time. The simulator has first been validated with deterministic histories. Random histories have then been run with exponentially distributed delivery times for the subassemblies and several families of random laws for the time spent in each workshop. Using Monte Carlo simulations, we obtain the distribution of the launch times. Preliminary optimization results allow choosing stock capacities and delivery rates that satisfy the launch schedule.

In this context, the PhD Thesis of Christophe Nivot (2013-2016) is funded by Chaire Inria-Astrium-EADS IW-Conseil régional d'Aquitaine.

## 7.2. Thales Optronique

**Participants:** Benoîte de Saporta, François Dufour, Alizée Geeraert.

Integrated maintenance, failure intensity, optimisation.

As part of optimizing the reliability, Thales Optronics includes systems that examine the state of their equipment. This function is performed by HUMS (Health Unit Monitoring Systems). The collaboration is the subject of the PhD of Alize Geeraert (CIFRE). The aim of this thesis is to implement in the HUMS a program based on observations that can determine the state of the system, optimize maintenance operations and evaluate the failure risk of a mission.

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



## **MC2 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. Bilateral Contracts with Industry**

Angelo Iollo is consulting with OPTIMAD engineering.

## **7.5. Bilateral Grants with Industry**

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

## **REALOPT Project-Team**

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

## **7.1. Contract with EDF on robust 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. We consider the large-scale power plant maintenance scheduling and production planning problem submitted by EDF to the 2010 Euro/Roadef Challenge. Two types of power plants are used to satisfy a customer demand over a specific time horizon. Type 1 plants can operate continuously while Type 2 plants have to be shut down regularly for refuelling and maintenance, and cannot produce during outage periods. The decision to be made consists of the dates of outages, the amount of refuel for Type 2 plants, and production level for both types of plants. The objective is to minimize the average cost of refuelling and production on various demand scenarios. We previously developed a column generation approach based on extended formulation which enables to solve within a few minutes a deterministic instance of the problem, which is within the time frame of the operational tools currently used by EDF. We now investigate stochastic and robust versions of the problem, where the duration of maintenance operations and the power demand are uncertain. Our approach is tested on real life instances within a rolling horizon framework.

## **7.2. Collaboration with ERTUS on phytosanitary treatment planning**

In planning winery operations (most importantly phytosanitary treatments on the wine tree) under weather forecast uncertainty, one searches for solutions that remain feasible and “cheap” in case of perturbation in the data. We consider the planning and scheduling of the operations that arise over a one-year horizon. More precisely, the operations to be scheduled include tasks related to soil care, or grape tree care: cutting, line building, thinning out leaves, ..., and chemical treatments. The latter are a main focus of our study since one of the principal goals of better planning is to reduce the amount of chemical treatments by selecting the appropriate products and schemes, but also by spacing out treatments while guarantying a disease free vineyard with some confidence. Each of the scheduled tasks requires its own resource, so the planning also triggers equipment and raw products selection decisions. The objective is to minimize both equipment and product costs augmented by an evaluation of the hazard of chemical product use. The planning should be “robust” to seasonal variations on the proper time frame for scheduling tasks.

## **7.3. Collaboration with Exeo-Solutions on dimensionning a vehicle fleet for waste collection**

Through the internships of Damien Trut and Youcef Magnouche in Exeo, and the current work of Pierre Pesneau, we study the optimization of partitionning a urban area into zones that shall be assigned to vehicles for waste collection. The goal is to minimize the distance traversed by the vehicles in each zone. This can be modeled as a clustering problem with side constraints: zones assigned to a same cluster must be contiguous and satisfy capacity and time constraints.

## **7.4. Collaboration with B-Travel on a yield management problem**

Through the PhD thesis of Martin Bué (in collaboration with inria team Dolphin), we are now working with society B-Travel on pricing and yield management. The goal is to find the best prices and incentives in the context of professional travel. The techniques used are based on network-flow formulations and mathematical programming.

### **7.5. Collaboration with Vekia on an employee-scheduling problem**

Through the PhD thesis of Matthieu Gérard (in collaboration with inria team Dolphin), we are now investigating a very rich version of employee-scheduling problem. We have designed an efficient algorithm for computing the best shift for each employee, based on dynamic programming. This method is used in a greedy algorithm to find solutions in a faster manner, and in a branch-and-price method to prove the optimality of the solution.

### **7.6. Collaboration with Renault S.A. on truck loading problem**

The goal of this one year industrial contrat was to analyze the algorithmic solutions used by Renault S.A. for packing items into trucks. The outcome of the contract was a report on their approach and how hints to improve it.

### **7.7. Collaboration with St-Gobain Recherche on glass cutting**

Through the internships of Quentin Viaud, we have studied a hard glass-cutting problem. The objective is to minimize the quantity of trim loss when rectangular pieces are cut from large rectangles. This first study has shown that our methodologies are able to cope with this problem for medium-sized instances. Solving the problem with large instances is a scientific challenge that we will address in the a follow-up contract. Quentin Viaud has begun a PhD thesis (CIFRE) in 2015 on this topic.

**CARMEN Team (section vide)**

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

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

## **7.1. Contracts with TOTAL**

- Depth Imaging Partnership (DIP)  
Period: 2014 May - 2019 April , Management: Inria Bordeaux Sud-Ouest, Amount: 12000 euros/year.
- Propagateurs optimisés pour les ondes élastiques en milieux anisotropes  
Period: 2011 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.
- Construction de milieux équivalents en vue de la simulation d'ondes élastiques harmoniques en milieux fortement hétérogènes par des méthodes DG  
Period: 2012 October - 2015 October, Management: Inria Bordeaux Sud-Ouest, Amount: 165000 euros
- Simulation de la propagation d'ondes élastiques et visco-élastiques en régime harmonique par des méthodes Galerkin discontinues d'ordre élevé en maillage non structuré adaptées au calcul haute-performance.  
Period: 2012 October - 2015 October, Management: Inria Bordeaux Sud-Ouest, Amount: 165000 euros

## **MAGNOME Project-Team**

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

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

MAGNOME and the company BioLaffort are contracted to develop analyses and tools for rationalizing wine starter strain selection using genomics.

MAGNOME and a consortium of academic (CNRS, INRA, INSA Toulouse) and industrial (Dassault Aviation, Airbus, Turbomeca, SNECMA, Air France, Total) partners coordinated by the French Institute for Petroleum and New Energies are contracted together on a large program of developing and testing alternative fuels for aviation, funded by the Civil Directorate for Aviation. MAGNOME's role is working with biological partners in developing genomic and genetic tools for oleaginous yeasts used in biofuel production.

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

## **SISTM Team**

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

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

Roche Institute, through the Vaccine Research Institute, funding one engineer over 2 years (2012-2014)

Cytheris (now RevImmune), through the ANRS, for the development of IL-7, as this is the only one company able to produce exogeneous IL-7 usable in Humans.



## **HIEPACS Project-Team**

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

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

Airbus Defence and Space research and development contract:

- Design of a parallel version of the FLUSEPA software (Jean-Marie Couteyen (PhD); Pierre Brenner, Jean Roman).

CEA DPTA research and development contract:

- Olivier merci de compléter, lien avec Runtime

CEA-CESTA research and development contract:

- Performance analysis of the recent improvements in PaStiX sparse direct solver for matrices coming from different applications developed at CEA-CESTA.

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); Mathieu Faverge, 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).

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

Airbus Group Innovations research and development contract:

- Design and implementation of FMM and block Krylov solver for BEM applications. The HiBOX project is led by the SME IMACS and funded by the DGA Rapid programme.

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

## **RUNTIME Team**

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

## **7.1. 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 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

CEA CEAI is granting the CIFRE PhD thesis of Emmanuelle Saillard (2012-2015) on Static/Dynamic Analysis for the validation and optimization of parallel applications and Grégory Vaumourin (2013-2016) on Hybrid Memory Hierarchy and Dynamic data optimization for embedded parallel architectures

CEA - REGION AQUITAINE CEA together with the Aquitaine Region Council is funding the PhD thesis of Marc Sergent (2013-2016) on Scalability for Task-based Runtimes.

## FLOWERS Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Bilateral Contracts with Industry

### 7.1.1. *Advanced platform for Urban Mobility (PAMU)*

**Participants:** David Filliat [correspondant], Emmanuel Battesti.

Development of extension of a planning algorithm on a autonomous electric car for Renault SAS. We improved a planning module in order to produce global plans to reach a goal specified in a digital map and to perform local reactive planning to avoid dynamic obstacles. This module is integrated in the PAMU autonomous vallet parking developed by Renault with several academic partners. The final demonstration of the system was made in october 2014.

## 7.2. Bilateral Grants with Industry

### 7.2.1. *Development of an Contextual electronic copilot for driving assistance*

**Participants:** David Filliat [correspondant], Alexandre Armand.

Financing of the CIFRE PhD grant of Alexandre Armand by Renault SAS with the goal of developping an Contextual electronic copilot for driving assistance based on the learning of the behavior of the driver.

### 7.2.2. *Curiosity and visual attention*

**Participants:** David Filliat [correspondant], Celine Craye.

Financing of the CIFRE PhD grant of Celine Craye by Thales S.A. with the goal of developing a mechanism of visual attention guiding the exploration of a robot.

### 7.2.3. *Auto-Apprentissage Auto-Adaptable pour la compliance au traitement*

**Participants:** Manuel Lopes [correspondant], Alexandra Delmas, Pierre-Yves Oudeyer, Benjamin Clement.

Financing of the CIFRE PhD grant of Alexandra Delmas by Itwell with the goal of developing a tool for self-learning for patients to improve their compliance to treatment.

## **MANAO Project-Team**

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

## **6.1. Bilateral Contracts with Industry**

- CIFRE PhD contract with Technicolor 2 (2014-2018)

**Participants:** A. Dufay, X. Granier, and R. Pacanowski

For this project, we aim at providing interactive previsualization of complex lighting with a smooth transition to the final solution.

## **POTIOC Project-Team**

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

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

### **Interactive Collaboration in Virtual Reality for Aerospace Scenarii:**

- duration: 2014-2017
- PhD Thesis of Damien Clergeaud
- partners: Airbus Group Innovations, Airbus Defence & Space
- The objective of this work is to explore the problems of remote collaboration in the context of virtual reality for aerospace applications. It relates to an interaction between an immersed user and remote operators equipped with various communication tools (desktop computers, tablets, touch tables...) or an interaction between a user and a remotely operated robot.