



RESEARCH CENTER
Bordeaux - Sud-Ouest

FIELD

Activity Report 2015

Section Contracts and Grants with Industry

Edition: 2016-03-21

1. CAGIRE Team	4
2. CARDAMOM Team	5
3. CARMEN Team (section vide)	6
4. CQFD Project-Team	7
5. FLOWERS Project-Team	9
6. GEOSTAT Project-Team	10
7. HIEPACS Project-Team	11
8. LFANT Project-Team (section vide)	12
9. MAGIQUE-3D Project-Team	13
10. MANAO Project-Team	14
11. MEMPHIS Team	15
12. MNEMOSYNE Project-Team	16
13. Monc Team (section vide)	17
14. PHOENIX Project-Team (section vide)	18
15. PLEIADE Team (section vide)	19
16. POSET Team	20
17. POTIOC Project-Team	21
18. REALOPT Project-Team	22
19. SISTM Project-Team (section vide)	24
20. STORM Team	25
21. TADAAM Team	26

CAGIRE Team

8. Bilateral Contracts and Grants with Industry

8.1. 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.

8.2. Bilateral Grants with Industry

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

CARDAMOM Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Participant: Pietro Marco Congedo [Corresponding member].

Several contracts have been realized:

- SAFRAN-HERAKLES, 20Keuros for the in-situ evaluation of the Cut-ANOVA and RobUQ codes.
- EXOES, 8 KEuros, for the analysis of the performances of the EVE engine, produced by EXOES.
- CNES, 15 KEuros, for the robust analysis of the DEBRISK code.

CARMEN Team (section vide)

CQFD Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. 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.

8.1.2. 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.

8.1.3. DCNS

Participants: Huilong Zhang, Jonatha Anselmi, François Dufour, Dann Laneuville.

This contract is with DCNS, a French industrial group specialized in naval defense and energy. In particular, DCNS designs and builds submarines and surface combatants, develops associated systems and infrastructure, and offers a full range of services to naval bases and shipyards, together with a focus into marine renewable energy. The main objective is to have robust algorithms able to build an accurate picture of the objects that are around a submarine by only using “passive sonar” information. This means that no information is transmitted by the submarine, which just listens to acoustic waves coming in, to the target. We estimate the position and the velocity of moving targets through noisy observations and a Kalman-type filter. Estimates become accurate depending on the type and the number of maneuvers done by the submarine. Our goal is to combine the filter that is currently used in DCNS with a Markov decision process. This provides a systematic framework to compute the best sequence of submarine maneuvers that allows the system to determine, as soon as possible, accurate target position and velocity. The current technological transfer to DCNS stands in a stochastic optimization framework developed in Matlab that operates under the hypothesis that the target follows a uniform linear motion with constant velocity or zero acceleration. The case where targets move in a more complex manner gives concrete perspectives for further transfers to DCNS.

FLOWERS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Advanced platform for Urban Mobility (PAMU)*

Participants: David Filliat [correspondant], Emmanuel Battesti.

We further developed a planning algorithm for 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. A milestone demonstration of the system was made at the 22nd ITS World Congress, in Bordeaux, on the 5-9 October 2015.

8.2. Bilateral Grants with Industry

8.2.1. *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 developing an Contextual electronic copilot for driving assistance based on the learning of the behavior of the driver.

8.2.2. *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.

8.2.3. *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.

GEOSTAT Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Geostat has been granted in 2015 a Carnot-Inria contact to fund a 1 year engineer to develop a prototype of a speech emotion detection system. This contact, led by K. Daoudi, is in collaboration with the start-up BatVoice which targets the commercialization of affect-interactive digital systems.
- Geostat has set up an industrial contract with **LECTRA Company**, on the development of nonlinear signal processing tools for analysis signals acquired from turbines.
- DGT Inria has funded a Proof of Concept on heartbeat analysis with IHU LIRYC.
- Patent: Geostat is in the process of depositing a patent on heartbeat signal analysis with the help of Inria Transfer and the *Cabinet Netter*.

HIEPACS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. 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:

- The objective was to evaluate if our ScalFMM library could be used to compute electrostatic interactions in molecular dynamics code (Stamp) of the CEA.

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 (Moustafa 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).

8.2. Bilateral Grants with Industry

Airbus Group Innovations research and development contract:

- Design and implementation of temporal FMM calculation (B. Bramas (PhD); Olivier Coulaud, Guillaume Sylvand).
- 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 (C. Piacibello (Engineer), Olivier Coulaud, Luc Giraud).

LFANT Project-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: 120000 euros/year.
- 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
- Méthodes d'inversion sismique dans le domaine fréquentiel
Period: 2014 October - 2017 December , Management: Inria Bordeaux Sud-Ouest, Amount: 180000 euros.

MANAO Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. 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.

MEMPHIS Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

We intend to pursue our partnership with Valeol, a wind turbine contractor in Aquitaine. Valeol poses simulation problems that cannot be addressed with standard tools. We have developed for them simplified PDE models for design in the frame of a industry funded PhD (CIFRE). We are currently adapting octree and Chimera approaches to the design of aerodynamic appendices to improve performance of existing installations. This is done in the frame of yet another CIFRE PhD thesis and the corresponding research contract. Moreover, thanks to this technology readiness, Valeol could join for the first time an H2020 research project, AEROGUST, that we are promoting with several academic and industrial institutions across Europe.

We continue to deploy our effort in flow control and drag reduction for ground vehicles. After a fruitful collaboration with Renault, we are in the phase of negotiating a new collaboration. A new collaboration is starting with Valeo to optimize car cooling devices. DNS simulations are performed and compared to the industrial results obtained with URANS and LES methods and an EU network about this subject is going to be proposed.

MNEMOSYNE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Contract with Algotech

Participants: Frédéric Alexandre, Ikram Chraïbi Kaadoud, Nicolas Rougier, Thierry Viéville.

Algotech is a SME working in the domain of CADD software edition for electrical circuit diagram interpretation and design. Its activity is interesting for our team because they are also interested in the design, by learning, of perception (for diagram identification) and action aspects of loops (for diagram genesis) with the specificity of working at a small scale, considering the variety of items to be manipulated. This is consequently a very interesting benchmark for transferring our bio-inspired models to the domain of classical machine learning, as we have begun this year.

Monc Team (section vide)

PHOENIX Project-Team (section vide)

PLEIADE Team (section vide)

POSET Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- PhD Grant CIFFRE, 2015-2018, for Jean-Michael Célérier, in partnership with **Blue Yeti** (Royan),

POTIOC Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Interactive Collaboration in Virtual Reality for Aerospace Scenarii:

- duration: 2014-2017
- PhD Thesis of Damien Clergeaud
- partners: Airbus Group
- The Airbus company regularly uses virtual reality for design, manufacturing and maintenance (see Figure 14). We work with them on collaborative interaction in order to enable an efficient collaboration between operators immersed in the virtual environment from remote locations and with heterogeneous equipment. More precisely, we have developed tools to point and manipulate objects, to remotely visualize the virtual environment, to be aware of remote manipulations and to describe tools and components trajectories.

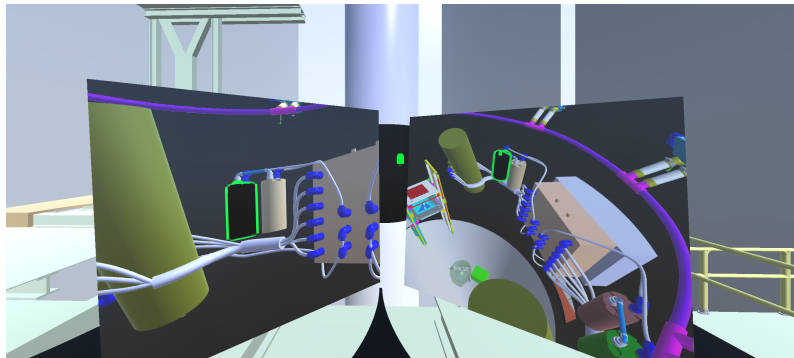


Figure 14. Example of a tool which allows to be aware of a remote place in a virtual reality application (Airbus collaboration)

REALOPT Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Contract with EDF on robust maintenance planning

Our project with EDF concerns the optimization of the long term energy production planning, allowing for nuclear power plants maintenance. The challenges are to handle the large-scale instance of a five year planning and to handle the stochastic aspects of the problem: the stochastic variation of the electricity demand, the production capacity and the duration of maintenance period. The key decisions to be optimized are the dates of outages (for maintenance) and the level refuelling that determines the production of the year to come. 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 approaches shall be evaluated on real life instances within a rolling horizon framework.

8.2. 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.

8.3. 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.

8.4. Collaboration with Asys on an employee-scheduling problem

Through the PhD thesis of Matthieu Gérard, we have investigated 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.

8.5. 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.

8.6. Collaboration with St-Gobain Recherche on glass cutting

Through the PhD of Quentin Viaud, we study 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-size instances. Solving the problem with large instances is a scientific challenge that we will address in the a follow-up contract.

SISTM Project-Team (section vide)

STORM Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

CodePlay A Contract has been established between CodePlay and Team Storm to experiment with the ComputeCpp compiler for the SYCL language and OpenCL based framework on hybrid, accelerated architectures.

8.2. Bilateral Grants with Industry

TOTAL SA 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 is granting the CIFRE PhD thesis of Emmanuelle Saillard (2012-2015) on Static/Dynamic Analysis for the validation and optimization of parallel applications, Grégory Vaumourin (2013-2016) on Hybrid Memory Hierarchy and Dynamic data optimization for embedded parallel architectures, Emmanuel Cieren (2012-2015) on Molecular Dynamics on Exascale Supercomputers, and Jean-Charles Papin (2013-2016) on Potential-based Dynamic Scheduling techniques and Partitioning tools for domain decomposition simulations.

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.

RAPID HiBOX This contract between IMACS an EADS France aims to develop a state of the art library for fast iterative, direct and hybrid methods, efficient on new heterogeneous parallel and hybrid architectures, that can be used on Boundary Element Methods. Applications targeted are acoustics, elastodynamics and electromagnetism. The contrat grants 2 year engineer for the parallelization of the library based on StarPU.

TADAAM Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with CEA

CEA is granting the PhD thesis of Hugo Taboada on specialized thread management in the context of multi programming models, and the PhD thesis of Rémi Barat on multi-criteria graph partitioning.

7.2. Bilateral Grants with Bull/Atos

Bull/ATOS is granting the CIFRE PhD thesis on Nicolas Denoyelle on advanced memory hierarchies and new topologies.

7.3. Bilateral Grants with Onera

Onera is granting the PhD thesis of Raphaël Blanchard on the parallelization and data distribution of discontinuous Galerkin methods for complex flow simulations.

7.4. Bilateral Grants with EDF

EDF is granting the CIFRE PhD thesis of Benjamin Lorendeau on new programming models and optimization of Code Saturn.