Activity Report 2016

Section Contracts and Grants with Industry

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Collaborative research contract with EDF (UPPA): "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.
- Collaboration contract "OpenLab Fluidics" with PSA (CNRS-UPPA): "Simulation numérique d'écoulements de convection naturelle typique des situations rencontrées dans l'espace sous-capot des véhicules automobiles".

8.2. Bilateral Grants with Industry

- PhD grant (CIFRE) of J.-F. Wald, EDF, defended in May 2016.
- Internship grant of S. Jameel, PSA, defended in September 2016.

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

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Several contracts have been realized:

- SAFRAN-HERAKLES, 20Keuros for the development of a code for computing low-probability.
- CNES, 10 KEuros, for the technological transfer of Sparse-PDD code.
- CEA 2015 10237, 60 Keuro for the supervision of the post-doc of Maxence Clayes by P.M. Congedo
- CEA 16-CIFRE PELUCHON, 20 Keuro for the supervision by L. Mieussens of the PhD of Simon Peluchon at the CEA-CESTA (1/1/15 - 31/12/17)
- BGS IT&E (2016-2018), 20 Keuro for a consulting by M. Ricchiuto on the implantation of some of the technology in the code SLOWS in their in-house model.

CARMEN Project-Team (section vide)

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

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 acustic 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.

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Autonomous Driving Commuter Car*

Participants: David Filliat [correspondant], Emmanuel Battesti.

We further developed a planning algorithm for a autonomous electric car for Renault SAS in the continuation of the previous PAMU project. We improved our planning algorithm in order to go toward navigation on open roads, in particular with the ability to reach higher speed than previously possible, deal with more road intersection case, and with multiple lane roads (overtake, insertion...).

8.2. Bilateral Grants with Industry

8.2.1. *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.

8.2.1.1. Adaptive device for disease awareness and treatment adherence of asthma in children

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

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.

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

7. Bilateral Contracts and Grants with Industry

7.1. Carnot-Inria

GeoStat has been granted in 2015 a Carnot-Inria project 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. The prototype was developed and transferred to BatVoice for 48000 euros. The phase 2 of the collaboration is under discussion. Engineer: N. Brodu.

7.2. Bilateral Grants with Industry

- With Batvoice company: *Détection des émotions à partir de la voix*. Startup Batvoice: M. Sendorek & G. Maluréanu.
- With CARDIOLOGS company, headed by Y. Fleureau. Contacts and first collaborations started in 2016.

Patent in the process of being first deposited in January 2017 *Dispositif analyseur de rythme cardiaque*, Inria-185.

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

Airbus Safran Launchers research and development contract:

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

Airbus Group Innovations research and development contract:

- Design and implementation of linear algebra kernel for FEM-BEM coupling (A. Falco (PhD); Emmanuel Agullo, Luc Giraud, 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)

<p align="center" style="color:red">MAGIQUE-3D Project-Team</p>

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.

- Méthodes d'inversion sismique dans le domaine fréquentiel

  Period: 2014 October - 2017 December , Management: Inria Bordeaux Sud-Ouest, Amount: 180000 euros.

- Portage de méthodes numériques de simulation de phénomènes complexes sur des architectures exascales

  Period: 2016 January - 2017 December , Management: Inria Bordeaux Sud-Ouest, Amount: 150000 euros.

- Approximations hybrides par éléments finis discontinus pour l'élasto-acoustique

  Period: 2016 November - 2018 October, Management: Inria Bordeaux Sud-Ouest, Amount: 165000 euros.

MANAO Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- CIFRE PhD contract with Technicolor (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.
- CIFRE PhD contract with FEI (2014-2018)
  Participants: D. Murray, and X. Granier
  For this project, we aim at providing expressive rendering techniques for volumes.

MEMPHIS Project-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 an 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.

This year, we have also developed an new collaboration with the CorWave (http://www.corwave.fr). CorWave develops blood pumps based on a unique and patented wave membrane pumping technology. This collaboration has begun with an industry funded PhD (CIFRE), officially for the early 2017. Antoine Fondaneche, the PhD candidate, is now employed by CorWave on a basis of a two-month CDD contract.

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 Chraibi 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 transfering our bio-inspired models to the domain of classical machine learning, as we have begun this year.

MONC Project-Team (section vide)

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

Funding for the DomAssist500 project was obtained from the following industrial partner: AG2R La Mondiale.

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),

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

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. 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 (see Section 7.5).

<div align="center" style="color:red">**REALOPT Project-Team**</div>

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 winary operations (most importantly phytosanitary treatments on the wine tree) under wheather forcast 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 sheduled 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 treatements while guaranting a desease free vineyard with some confidence. Each of the scheduled tasks requires its own resource, so the planning also triggers equipement 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 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.

8.4. Collaboration with Greycon Ltd. on industrial cutting

Through a research internship, we have studied a hard one-dimensional industrial cutting problem with manu practical constraints. We have designed a non-standard diving heuristic , where some complicating constraints are handled trough branching. Our heuristic was able to improve the solutions found by the industrial partner for several hard instances.

8.5. Collaboration with SNCF on timetable and rolling stock rotation planning

Our projet with SNCF concerns the optimisation of timetable and rolling stock rotation planning. The railway production planning process combines heterogeneous resources and is usually decomposed into different sequential sub-problems, beginning by line planning, timetabling, rolling stock rotations and crew scheduling. Our goal is to solvie the timetable and rolling stock problems in an integrated manner. Given a line planning and service requirement constraints, the problem is to produce a timetable for a set of trains and the objective is to minimize the cost of the railcars used. An originality of our approach is to deal with railcars composed of multiple units, which can be coupled or decoupled at some stations. The PhD thesis of Mohamed Benkirane is funded by this project.

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Implication in research for the development of vaccine has lead to a direct contracts with industry such as withs Iliad Biotechnologies. This contract had been signed for the BPZE-1 pertussis vaccine trial. This study evaluates the safety and immunogenicity of a higher dose formulation of a new live attenuated vaccine, BPZE1, intended to prevent Bordetella pertussis nasopharyngeal colonization and pertussis disease, and investigates whether higher doses of BPZE1 induce the live vaccine to colonize subjects' nasopharynx. The study is a Phase Ib (high dose), single centre, dose-escalating, placebo-controlled study of the live attenuated B. pertussis strain BPZE1 given as a single intranasal dose to healthy adult volunteer. This contrat is part of the EUCLID platform (via the CIC 1401) in which Laura Richert and Rodolphe Thiébaut are involved.

8.2. Bilateral Grants with Industry

Implication in research for the development of Ebola vaccine has lead to several indirect contracts with industry:

- The EBOVAC2 project, which is presented in Section 'FP7 & H2020 Projects', leads to collaboration with Janssen from Johnson et Johnson.

- The BPZE-1 pertussis vaccine trial , which is presented in Section 'Bilateral Contracts with Industry', leads to collaboration with Iliad Biotechnologies. (Via the EUCLID platform and CIC 1401)

- The Prevac trial vaccine trial leads to collaboration with Merck. The purpose of this study is to evaluate the safety and immunogenicity of three vaccine strategies that may prevent Ebola virus disease (EVD) events in children and adults. Participants will receive either the Ad26.ZEBOV (rHAd26) vaccine with a MVA-BN-Filo (MVA) boost, or the rVSVΔG-ZEBOV-GP (rVSV) vaccine with or without boosting, or placebo. (Via the EUCLID platform and CIC 1401)

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

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- HiBOX project, with Airbus and IMACS (2013-2017).
- CEA contracts:
  - Several PhD contracts: for Hugo Brunie, Raphaël Prat, Marc Sergent and Arthur Loussert.
  - Industrial contract with CEA-DAM on particle simulation.

<div align="center" style="color:red">

TADAAM Team

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8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contract 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.

8.2. Bilateral Grant with Bull/Atos

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

8.3. Bilateral Grant 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.

8.4. Bilateral Grant with EDF

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

8.5. Bilateral Grant with Intel

Intel is granting $30k and providing information about future many-core platforms and memory architectures to ease the design and development of the HWLOC software with early support for next generation hardware.