



RESEARCH CENTER
Bordeaux - Sud-Ouest

FIELD

Activity Report 2018

Section Highlights of the Team

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LFANT Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

Chloe Martindale defended her PhD thesis on *Isogeny Graphs, Modular Polynomials, and Applications*.

Antonin Riffaut defended his PhD thesis on *Effective computation of special points*.

A new release of PARI/GP, 2.11.0, has been published. This is a major stable release ending a development cycle which started in November 2016; it includes among others an extensive new package for modular forms.

2018 was also a year with more workshops on PARI/GP than ever: Besides two general workshops uniting developers and users, organised together with the universities of Besançon and Rome in the respective cities, the team participated with lectures on PARI/GP at the École jeunes chercheurs en théorie des nombres à Besançon (<https://indico.math.cnrs.fr/event/2735/>) and at the summer school ZETAS 2018 at Le Bourget du Lac (<https://etzetas2018.sciencesconf.org/>).

CAGIRE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

ANR MONACO_2025

The ANR MONACO_2025 project started in March 2018. The consortium of this project, coordinated by [RM], consists in an academic partner, the institute PPrime of Poitiers, and two industrial partners, PSA and EDF. It is focused on the the development of a CFD methodology for transient, buoyancy-affected turbulent flows, that are crucial for the two industrial partners. Four PhD students, Saad Jameel (CIFRE PSA grants), Puneeth Reddy (ANR grant), Gaëtan Mangeon (CIFRE EDF) and Vladimir Duffal (CIFRE EDF) are involved in this project, which plays a major role in the active collaboration among these students.

A new industrial partner

A collaboration started in 2018 with a new industrial partner, Dassault Aviation, via the CIFRE PhD of Gustave Sporschill supervised by Rémi Manceau.

A new regional initiative

Cagire is part of the 3-year program HPC scalable ecosystem funded by Région Nouvelle-Aquitaine in the framework of its 2018 call.

HTLES in the commercial code CONVERGE

In the framework of the IFPEN PhD thesis of Al Hassan Afailal (supervision by Rémi Manceau), the hybrid RANS/LES method developed in the project-team CAGIRE has been implemented in the commercial software CONVERGE (<https://convergecf.com>).

CARDAMOM Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

- On Tuesday, 19 June, the Project AMDECC (Adaptation de Maillage Dynamique et massivement parallèle pour la simulation aux grandes Echelles des Chambres de Combustion aéronautiques), launched 5 years ago within a partnership with Safran Tech and the CORIA (UMR6614 CNRS Université de Rouen and INSA Rouen), received the Award for Best Collaborative Project, one of the Digital Simulation Trophies awarded by Teratec and Usine Digitale. The aim of this project is to design helicopter engines that afford better, and cleaner, performance. To achieve this, the team uses large-scale simulations of engine combustion chambers with a view to improving quality-to-cost ratio. Optimising the simulations is key to the project's success since this approach requires intensive use of high-performance computing. Adaptation is performed with the MMG platform developed by C. Dobrzynski. For more information see <https://www.inria.fr/en/centre/bordeaux/news/amdecc-project-wins-award-at-teratec-forum> and <https://www.mmgtools.org>.
- One of the articles of M. Colin, 'Standing waves for the nonlinear Schrödinger equation coupled with the Maxwell equation', published in Nonlinearity, has been selected for the journal's 2017 Highlights Collection<<http://iopscience.iop.org/journal/0951-7715/page/Highlights-of-2017>>.

CQFD Project-Team (section vide)

GEOSTAT Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Technology transfer and socio-economic impact: InnovationLab i2S-GEOSTAT. Three year contract with I2S company on the transfert of award winning H. Badri PhD results (AFRIF PhD price in 2016). The contract is being transformed in 2018 in the form of an Inria Innovation Lab. The Innovation Lab is focused on non convex optimization methods in image processing and digital acquisition devices. People involved in GEOSTAT: H. Yahia, N. Brodu, K.Daoudi, M. Martin, A. Zebadua. Budget: 900 000 € on 3 years. The InnovationLab is intended at transferring non-convex optimization methods to solve efficiently the fundamental steps of an imaging acquisition chain built by i2S company. In particular, the following thematics receive new algorithmic solutions through proximal operators and non-convex optimization:
 - Image smoothing
 - Image denoising
 - Efficient block-matching implementation
 - Denoising through learning
 - Low rank transfert
 - Debayerisation
 - Image stitching
 - Deconvolution
 - 3D reconstruction from corrupted gradients
 - Super-resolution
 - Image enhancement

This InnovationLab is operated by GEOSTAT researchers, 1 PhD, 2 post-docs and 1 engineer. C++ libraries are developed and transferred into the algorithmic chain at i2S.

- Research results done by GEOSTAT and LEGOS on greenhouse gases partial pressures at the atmosphere/ocean interface layers put forward on ESA site. Read : "[Increasing the effective resolution of not well-resolved Essential Ocean Variables](#)".
- IFCAM (Indo-French Center for Applied Mathematics) project accepted: "Generalization for land cover classification" by Dharmendra Singh and Nicolas Brodu.

MEMPHIS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Turbulent flow simulations using Octrees

We have initially developed and tested a 3D first-order Octree code for unsteady incompressible Navier-Stokes equations for full windmill simulations with an LES model and wall laws. We have validated this code on Occigen for complex flows at increasing Reynolds numbers. This step implied identifying stable and feasible schemes compatible with the parallel linear Octree structure. The validation has been conducted with respect to the results of a fully Cartesian code (NaSCAR) that we run on Turing (with significantly more degrees of freedom) and with respect to experimental results.

Subsequently, we have developed a second-order Octree scheme that has been validated on Occigen for a sphere at a moderate Reynolds number ($Re = 500$), see Table 1 . Then, for a cylinder at ($Re = 140000$) (Figures 5 (a) and 5 (b)), close to real applications, we have preliminary validation results for the second-order scheme with respect to experimental drag coefficient (Table 2). Additional resources will be asked on Occigen to complete the study.

Table 1. Flow past a sphere at $Re = 500$. Results in the literature are spread between $C_D = 0.48$ and $C_D = 0.52$.

Mesh	Δx_{\min}	number of cells	C_D (1 st -order scheme)	C_D (2 nd -order scheme)
1	0.094	$0.72 \cdot 10^5$	N.A.	0.526
2	0.047	$4.9 \cdot 10^5$	0.595	0.522
3	0.023	$4.7 \cdot 10^6$	0.546	0.492
4	0.012	$37.6 \cdot 10^6$	0.555	0.496

Table 2. Flow past a sphere at $Re = 14000$.

Case	C_D
Octree, 1 st -order scheme	1.007
Octree, 2 nd -order scheme	1.157
Cartesian	1.188
Experimental estimate [31]	1.237

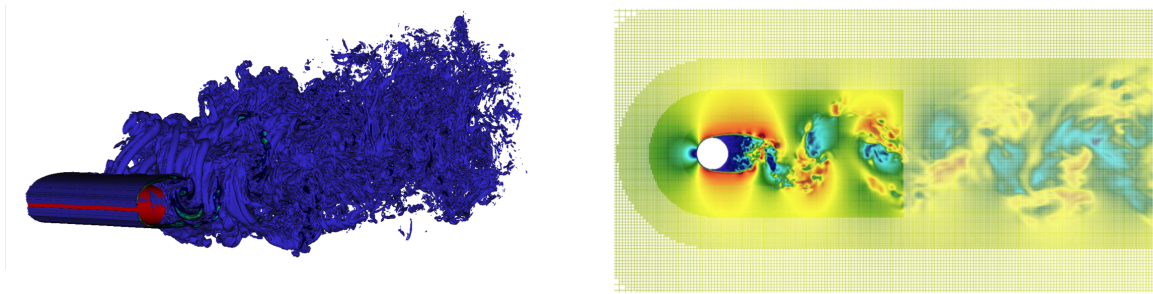


Figure 5. flow past a cylinder at $Re = 140000$. Left: vorticity contour lines. Right: streamwise velocity section and grid for the second-order Octree scheme.

REALOPT Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

François Vanderbeck was chair of the organizing committee of ISMP'2018. ISMP is the triennial international congress of mathematical optimization, where scientists from all over the world as well as industrial practitioners of mathematical optimization meet in order to present their most recent developments and results and to discuss new challenges from theory and practice. It is the symposium of the Mathematical Optimization Society (MOS). More than 1900 scientists attended the conference this year in Bordeaux.

Olivier Beaumont was the program chair of the IEEE-ACM HiPC conference held in Bangalore in December 2018.

The team decided to develop an open-source platform, called coluna, to allow the scientific committee to use our state-of-the-art algorithms for extended formulations.

A first spinoff company is being created by RealOpt members.

CARMEN Project-Team (section vide)

MAGIQUE-3D Project-Team (section vide)

MNEMOSYNE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

We published this year an important article [3], together with neuroscientist colleagues in our laboratory. We are particularly proud of this paper because it illustrates a very fruitful cooperation between modeling and experimental analysis, particularly allowing to revisit current views about a dogma in neuroscience, concerning the place where habits are learned and their role in cognition.

MONC Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- S. Benzekry was nominated expert within the scientific board of the national multi-thematic institute (ITMO) Cancer of the French alliance for health sciences (AVIESAN).
- In collaboration with the experimental team of the SMARTc unit of the Center of Cancer Research of Marseille (CCRM), we published the results of a four-years long study for optimizing the sequence and schedule of antiangiogenic-cytotoxics combinations in the treatment of non-small cell lung cancer [7]. With the objective to determine an optimal interval between the administration of the two types of drugs (currently administered concomitantly in the clinic), we validated a research strategy that consisted in three steps: 1) Initial experiments, 2) Calibration and refinement of a mathematical model adapted to the data and 3) experimental validation of the predictions of the calibrated model (superiority of a 3 days time interval).

PLEIADE Team

5. Highlights of the Year

5.1. Highlights of the Year

Pascal Durrens was promoted this year to the new grade of *Chargé de Recherche Hors Classe* of the CNRS.

SISTM Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Launch of the Graduate's School Digital Public Health (PI: R Thiebaut) including the Master of Public Health Data Sciences
- Launch of the IMI project EBOVAC3 in which R Thiebaut is leader of the workpackage "Modelling". Concomitantly, we have obtained the first results of the modelling of the response to the Ebola vaccine developed with Janssen company (submitted to Journal of Virology).
- A new step of the work on IL-7 therapy in HIV infected patients has been achieved through the optimization of the administration of the injections. Approaches from statistical modelling and control theory demonstrated the feasibility of reducing the administration of IL-7 while improving its efficacy.
- The project on the automatic recognition of cell populations through high dimensional cytometry data has reached a successful stage with two important publications. It is now applied to clinical trial datasets available through the Vaccine Research Institute.
- The data warehouse system developed through the EHVA European consortium is settled in its version 1.0 and will be used for the storage of all SISTM datasets as well as to implement the software developed for the analysis of immunological data.
- Funding of the EDCTP Prevac-UP in which M Prague is leader of the workpackage "System vaccinology approach". The aim is to develop an integrative analysis of all immunological data generated to understand antibodies response to Ebola vaccination.
- Funding of the Franco-Sino INSERM project on NiPAH virus in which M Prague is leader of the workpackage "Modeling, biostatistics and bioinformatics". The aim of this workpackage is to conduct state of the art quantitative analyses of effects of therapeutic and vaccine strategies, as well as providing a framework to bridge results from in vitro to in vivo and between different animal models.
- Marta Avalos undertook a 6-month research visit to Data61 (CSIRO, Canberra, Australia) in 2017. This collaboration has reached a successful stage with one publication in NeurIPS 2018.

HIEPACS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

The year 2018 was rich in regional, national and European calls for projects. This year, our success rate was quite high for the proposals we submitted; four of them went through: one ANR, namely **SASHIMI**, a major regional project, namely hpc-ecosystem benefiting many EPIs in Inria Bordeaux Sud-Ouest, and two H2020 projects, namely **EoCOE** and **PRACE-6IP**. These projects will provide new applications and collaborative frameworks to support our ongoing and future research and transfert activities.

PHOENIX-POST Team (section vide)

STORM Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- “Habilitation à diriger les recherches” (HDR) of Samuel Thibault, Dec.2018.

TADAAM Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Guillaume MERCIER is the chairman of the Hardware Topologies Management Working Group of the MPI Forum. This working group was created officially in December by Inria's impulse and has been rallied since by many institutions taking part in the MPI Forum. The goal of this working group is to standardize hardware topologies management mechanisms and abstractions in the MPI standard.

AUCTUS Team

5. Highlights of the Year

5.1. Highlights of the Year

- David Daney and Cyril Dané (AIO) were invited to the Élysée Palace to present the Numii system,
- Anna Pugach and David Daney have filed a patent entitled “Intelligent Textile Adapted for Motion and/or Deformation Detection”

FLOWERS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- PY Oudeyer was awarded the prize Inria of Académie des Sciences (category young researchers, <http://www.academie-sciences.fr/fr/Laureats/laureats-2018-prix-inria.html>)
- The Poppy Education ecosystem of educational robotics kits, associated technologies and educational community created by the Flowers team has been transferred to the newly created Poppy Station association (the creation process being coordinated by Didier Roy), gathering large scale national organizations including Ligue de l'enseignement, Hesam, IFE, EPFL, Arts et Métiers ParisTech, CESI, Le Cnam, Generation Robots, Pollen Robotics, Konex inc, see <https://www.poppystation.org/>
- PY Oudeyer co-authored with his collaborator Jacqueline Gottlieb (Columbia Univ., NY) a review article [22] in the high impact journal Nature Reviews Neuroscience, entitled "Towards a neuroscience of active sampling and curiosity", <https://www.nature.com/articles/s41583-018-0078-0>
- PY Oudeyer co-organized (with J. Gottlieb, A. Shankar and P. Zurn) the international conference "Curiosity: Emerging Sciences and Educational Innovations" at University of Pennsylvania, US, gathering researchers from multiple disciplines (neuroscience, psychology, artificial intelligence, HCI, robotics, philosophy, education) around the topic of curiosity, learning and education. <https://www.sp2.upenn.edu/sp2-event/curiosity-emerging-sciences-and-educational-innovations>.

MANAO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Our paper on instant computation of transport maps was accepted for presentation at the prestigious conference Siggraph Asia and will be published in the journal ACM Transactions on Graphics [5].

5.1.1. Awards

Best paper and presentation award at EGSR 2018 .

BEST PAPERS AWARDS :

[3]

P. BARLA, R. PACANOWSKI, P. VANGORP. *A Composite BRDF Model for Hazy Gloss*, in "Computer Graphics Forum", 2018, vol. 37 [DOI : 10.1111/CGF.13475], <https://hal.inria.fr/hal-01818666>

POTIOC Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Inner Garden will be presented at CES 2019 for which the Ullo company won an award "Tech for a better world"
- Publication of "Virtual Reality and Augmented Reality: Myths and Realities" [42]. This book has been written by 30 academics and engineers working in french labs and companies under the supervision of Bruno Arnaldi (INSA Rennes), Pascal Guitton (Potioc) and Guillaume Moreau (Centrale Nantes). It discusses various aspects : hardware, software, applications, ethics issues... It covers the previous 10 years and give some prospective elements for the future. (the french edition is also available [41]).
- Winner of Bourse Déclic jeunes, Fondation de France, Lauren Thévin

5.1.1. Awards

- Best Demonstration award IHM 2018 [61],
- Hackathon BR41N.IO, 7th BCI Meeting 2018, Asilomar, May 20-21st 2018, 1st winning group, Léa Pillette
- UIST conference hackathon winner, Berlin, Germany, October 2018, Aurélien Appriou
- Student Travel Award (Asilomar BCI Meeting, California) (May 2018), Jelena Mladenovic
- Student Travel Award (UbiComp conference, Singapore) (October 2018), Jelena Mladenovic