RESEARCH CENTER
Bordeaux - Sud-Ouest

FIELD

Activity Report 2017

Section Highlights of the Team

Edition: 2018-02-19

CAGIRE Project-Team

5. Highlights of the Year

5.1. ANR MONACO_2025

The MONACO_2025 proposal has been selected by ANR. In addition to Cagire, 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. This project built up on the long-term collaboration with EDF, and the more recent collaboration with PSA through a master internship and the CIFRE PhD thesis of Saad Jameel.

5.2. First implementation of a turbulence model in AeroSol

In the long-term strategy of the CAGIRE team, the development of agile simulation, a first step towards auto-adaptive RANS/LES methods was made this summer during the internship of Axelle Perraud. This step consisted in the implementation in AeroSol of a first near-wall resolving turbulence model. Before focusing on innovative RANS and hybrid RANS/LES methods developed in CAGIRE, it was chosen to implement the standard, well-established k-ω RANS model, in order to make possible a straightforward validation in comparison with other CFD codes.

CARDAMOM Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- CARDAMOM has passed with success its first evaluation in March 2017
- The associated team HAMSTER between CARDAMOM and the Department of Civil engineering of Duke University has been created in January 2017
- The associated team COMMUNES between CARDAMOM and the CWI in the Netherlands has been created in January 2017
- The open-source consortium around the Mmg platform has been created, and Mmg will now be part of the projects managed by Inria Soft

CARMEN Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

Michał Kania received a Gary and Bill Sanders poster award for his contribution “Prediction of the Exit Site of Ventricular Tachycardia Based on Different ECG Lead Systems” to the Computing in Cardiology meeting in Rennes, September 2017 .

5.1.2. Inria domain evaluation

In October the Carmen team participated in the evaluation of the Inria domain Life sciences, theme *Modeling and Control for Life Sciences*, during a 3-day seminar in Paris. The report was very positive about our work in general. The jury, composed of high-profile international scientists, noted especially the development of a bilayer model of the atria [56], [50] [15], the modified monodomain model which can reproduce much of the much more expensive bidomain model [49], and our contributions to electrocardiographic imaging [24], [17], [23], [27].

BEST PAPERS AWARDS :

[25] **Computing in Cardiology**. M. KANIA, Y. COUDIÈRE, H. COCHET, M. HAÏSSAGUERRE, P. JAÏS, M. POTSE.

CQFD Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Pierre Del Moral is a Simons foundation CRM Professor, Montréal Math. Research Center 2017

Google scholar classic paper in Probability and Statistics (ten most-cited articles published ten years earlier): Del Moral, P., Doucet A., Jasra A.. *Sequential Monte Carlo Samplers* Journal of the Royal Statistical Society, Series B, vol. 68, no. 3, pp. 411-436 (2006).

FLOWERS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- P-Y. Oudeyer was invited to give the 29th Eleanor J. Gibson and James J. Gibson Lecture in Experimental Psychology, by Cornell University, US.
- P-Y. Oudeyer co-organized with colleagues at Univ. Waterloo (Canada) the interdisciplinary workshop "Designing for curiosity" at CHI 2016 in Denver, Colorado, US. This workshop aimed to build a community of academic researchers-such as computer scientists (in human-computer interaction, artificial intelligence, robotics), developmental psychologists, behavioral economists, education, marketing, neuroscience-as well as practitioners-such as painters, architects, game designers, screenwriters who have engaged with the term curiosity in their work. Web site: https://www.crowdcurio.com/research/workshops/chi2017/.
- P-Y. Oudeyer co-organized (with V. Santucci, G. Baldassarre, A. Barto) the 3rd International Workshop on Intrinsically Motivated Open-Ended Learning (IMOL 2017). It aimed to further explore the promise of intrinsically motivated open-ended lifelong learning in robots and artificial systems. Web: http://www.imol-conf.org/. We also organized a follow-up special issue in the journal Fronties in Robotics and AI:
http://goo.gl/YkMYNN.
- The Flowers team organized the 3rd "Colloque Robotique et Education" in Bordeaux (general chair: Didier Roy), gathering around 200 attendees on the topic of educational robotics. Web: http://dm1r.fr/roboeduc17/. The team also contributed to the organization of the Scratch international conference, web:http://www.scratch2017bdx.org/en/hello-world-2/.
- The Flowers team, the Potioc team and two research teams in robotics and HCI at the University of Waterloo (Canada) initiated a new interdisciplinary collaboration around the design of interactive environments that foster curiosity-driven learning, and obtained a funding from Idex/University of Bordeaux.

GEOSTAT Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Innovation LAB GEOSTAT-I2S based on 3 year contract with I2S company on non convex optimization methods for image processing.

5.1.1. Awards

A. Tamim, PhD Student in Geostat, wins the gold medal of Hubert Curien PhD prize 2017. A. Tamim's PhD title: "Segmentation et classification des images satellitaires : application à la détection des zones d'upwelling côtier marocain et mise en place d'un logiciel de suivi spatiotemporel". See https://www.inria.fr/centre/bordeaux/actualites/prix-de-these-pour-ayoub-tamim.

HIEPACS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

We have presented two approaches using a Block Low-Rank (BLR) compression technique to reduce the memory footprint and/or the time-to-solution of the sparse supernodal solver PaStiX. Thanks to this compression technique, we have been able to solve a 1 billion unknown system (a 3D Laplacian matrix $100 \times 100 \times 100.000$) on a single node with 3Tb of memory. The factorization time for this system was less than 6 hours using 96 cores, and the precision achieved at the first solve was 10^{-5}. With 10 additional iterative refinement steps, we reached easily 10^{-8} in double precision. The cost of one solve was limited to 280 seconds. We were able to save 9Tb over the 11Tb that would be requested by the direct solver. The last release of the software (PaStiX 6.0) includes these implementations and the description of the parameters are documented in solverstack/pastix.

2017 has been the last year of the FASTLA associate team that has been for 6 years the framework of fruitful and intense research collaborations with Lawrence Berkeley National Laboratory and Stanford University on data sparse numerical algorithms; the joint research addressed especially fast multipole techniques and low rank calculation in sparse linear algebra. This successful collaboration has been concluded by the participation of E. Ng, head of Applied Mathematics Department at Berkeley, to the two HDR juries of A. Guermouche andP. Ramet that have been defended on the same day, November 27th.

LFANT Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

Aurel Page has been recruited as a Inria CR in the team.

Damien Robert organised a one-week workshop with the members of the associated team FAST with several African countries.

The book [17] by Henri Cohen on *Modular Forms: A Classical Approach* has been published.

4.1.1. Awards

The paper [] describing Arb in the IEEE Transactions on Computers was selected as the best paper of this journal's Special Issue on Computer Arithmetic.
BEST PAPERS AWARDS :
[] **IEEE Transactions on Computers**. F. JOHANSSON.

MAGIQUE-3D Project-Team (section vide)

MANAO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

We are regularly publishing our work at the prestigious conference Siggraph. This year was particularly successful with three plain papers [11], [12], [14].

MEMPHIS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Memphis team of Inria and VALOREM are both involved in the european project AeroGust (Aeroelastic gust modelling). One of the task aims to investigate the behaviour of wind turbine blades submitted to gust using incompressible flow model and Octree grids. An other task is to carry on an experimental work on a wind turbine. Interests will be first to have real data and use it to better understand the effects of wind and more precisely of gusts, on wind blades. A second interest is to use experimental data to calibrate our numerical schemes in the high-fidelity CFD code.
The measurement of the wind was considered as the most important data to be obtained from the very start of the project. Indeed, this data will be used as a key input for the numerical simulations. This is needed to represent the wind as it arrives at the wind turbine. Then, wind turbine data collection aims to observe the aero-elastic behaviour of wind blades. So, the measurement of blade deformations will allow to check the structural beam model of the blade and to observe its structural behaviour. To observe the aerodynamic load on the wind blade, the measurement of pressure of air on the blade is of significant interest.
A meteorological mast has so been installed in March 2017 in Brittany (France) to measure wind on-site. In figure 5 can be seen a photograph of the whole mast after its installation. Figure 6 contains a picture focused on the sensors of the met mast which are wind vanes for the direction and anemometers for the velocity.

Figure 5. Photo of the met mast after its installation

For the instrumentation of the wind blade, the setup consists of 4 optical fibres along the blade. Each fibre has 4 sensors (pressure or strain gauges) and also temperature sensors at different lengths in order to calibrate the other sensors with respect to temperature. 10 strain gauges and 6 pressure sensors have so been installed on a wind blade located near the meteorological mast (in a way that in the main wind direction, the met mast and the wind turbine are aligned). In figure 7 , the 2 lines of sensors going along the pressure side and the leading edge of the wind blade can be seen.

Figure 6. Photo of the sensors on the met mast

Figure 7. Photo of the pressure side of the wind blade after instrumentation

Work is now in progress with the experimental data in order to identify different gust conditions in the field and to analyse the effects on the blade deformations. One of the outcomes will be then to compute simulations with our high-fidelity numerical tool developed with VALOREM. This comparison will allow us to calibrate the numerical schemes thanks to real test data.

MNEMOSYNE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

We published this year an important article [4] gathering 45 co-authors about the ReScience initiative which makes an important contribution that traditional scientific journals cannot offer. It provides a venue for publishing replication work, which traditional journals exclude for lack of novelty. Considering the ever increasing importance of computational methods in all scientific disciplines, we believe that our approach to replication is of interest to a broad audience of researchers.

MONC Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

The team published in medical journals with strong impact factors like Cancer Research (*Mathematical modeling of tumor-tumor distant interactions supports a systemic anti-proliferative control of tumor growth* by S. Benzekry, *et al* for instance).

A new promising collaboration has started with the group of Yuval Shaked (double ERC laureate) at the Technion Israel Institute of Technology and first joint publication *Dose- and time-dependence of the host-mediated response to paclitaxel therapy: a mathematical modeling approach* by Benguigui *et al* will appear in Oncotarget, 2017.

Sébastien Benzekry received of the title of Assistant Associate Professor in the Department of Medical Biosciences of Iowa State University, reinforcing a starting collaboration with Jonathan Mochel about PK/PD modeling for comparative oncology.

Two former members of the team (Thierry Colin and Vivien Pianet) were hired by Sophia Genetics (http://www.sophiagenetics.com) to build its new imaging department and developed works initiated in Monc.

PHOENIX Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

The College+ software, an assistive application on iPad for children with Autism Spectrum Disorders included in ordinary schools, has been distributed on the Apple store, starting in October 2017.

https://itunes.apple.com/us/app/college/id1289697202

PLEIADE Team (section vide)

POTIOC Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- A Handbook of Brain-Computer Interfaces was co-edited by Potioc (F. Lotte), involving the international BCI community [41]

5.1.1. Awards

- Best paper - Honorable mention award (top 5% over 2400 submissions), ACM CHI 2017, HOBIT, D. Furio, S. Fleck, B. Bousquet, J.-P. Guillet, L. Canioni, M. Hachet
- Best paper - Honorable mention award (top 5% over 2400 submissions), ACM CHI 2017, Inner Garden, J. S. Roo, R. Gervais, J. Frey, M. Hachet
- Honorable mention award, MUM'17, Bespoke map customization, A. Brock, B. Hecht, B. Signer, J. Schöning
- Best technnote award, IEEE 3DUI 2017, Hybrid space, J. S. Roo, M. Hachet
- Best Demo award for Teegi, IHM 17, T. Lainé, J. Frey, M. Hachet
- PhD thesis award, International PhD award committee from Bordeaux University 2017, C. Jeunet
- PhD thesis award, IFRATH/KAELIS 2017, C. Jeunet
- PhD thesis award, SMC Grant Initiative 2017 for the "Best PhD Thesis in Human-Machine Systems", C. Jeunet
- 2 Publons top peer reviewer awards in 2017, for the top 1% most peer reviews in both Engineering in Neuroscience, F. Lotte

BEST PAPERS AWARDS :

[24] **CHI'17 - Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems**. D. FURIO, S. FLECK, B. BOUSQUET, J.-P. GUILLET, L. CANIONI, M. HACHET.

[32] **CHI '17 - International Conference of Human-Computer Interaction**. J. SOL ROO, R. GERVAIS, J. FREY, M. HACHET.

[17] **MUM 2017 - 16th International Conference on Mobile and Ubiquitous Multimedia**. A. BROCK, B. HECHT, B. SIGNER, J. SCHÖNING.

[30] **3DUI - IEEE Symposium on 3D User Interfaces**. J. S. ROO, M. HACHET.

REALOPT Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Olivier Beaumont was the Track Chair of the Algorithm Track of Super Computing 2017 (November, Denver, USA); "The International Conference for High Performance Computing, Networking, Storage and Analysis" https://sc17.supercomputing.org. SuperComputing is the major international conference on High Performance Computing.

We have contributed to the JULIA mathematical programming ecosystem by providing tools to decompose a mixed integer programming model into blocks. This makes it very convenient to model Benders or Dantzig-Wolfe decomposition using JUMP and to compare different decomposition for a given problem formulation.

Our generic software platform BaPCod is now giving rise to specific branches for classes of applications. The first such release concerns the classic benchmark Vehicle Routing Problem variants that arise in logistics. The methods that are build in the platform emerge from our collaboration with our Brazilian partners of the SAMBA associated team. For their anterior work, our partners have received the 2017 best paper award from the prestigious journal "Mathematical Programming Computation". With the new version that is built under BaPCod, we have managed to solve to optimality many more open instances of classic and very competitive Vehicle Routing Problem with Time Windows [37]. This study has been an opportunity to improve significantly the performance on the generic Branch-Cut-and-Price platform and to highlight the interests of such generic methodologies.

SISTM Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Funding by PIA3 of the Bordeaux Graduate's School in Digital Public Health, headed by Rodolphe Thiébaut. This Master/PhD program is built with the expertise coming from the Inria Sistm project team and in collaboration with several other teams (MONC, CARMEN, PHOENIX).

Successful application of integrative analyses tools on high dimensional immunogenicity data from an Ebola vaccine trial with identification of early correlates of later antibody responses [30]

We published a milestone paper in Biometrics comparing descriptive models (Marginal structural models) and mechanistic models (Ordinary differential equations with mixed effect models on parameters). This is impactful as it shows that mechanistic models can adequately estimate a treatment effect in time-varying confounders settings as it is in observational studies. This opens the perspective of in silico trials based on predictions based on the analysis of available cohorts. [26]

We published a robust and powerful statistical method to analyzed longitudinal RNAseq data, largely outperforming state-of-the-art methods. With the surge in RNAseq data production, e.g. in system vaccinology, this principled methodology has a broad impact in deepening our understanding of underlying molecular mechanisms in various contexts, paving the way for further biological innovation. [16]

5.1.1. Awards

The University of Bordeaux Initiative of Excellence (IdEx) and Zellidja travel grants for a research PhD student visit of 3 months to the CSIRO's machine learning Data61 team, Canberra, Australia (Perrine Soret).

STORM Project-Team (section vide)

TADaaM Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Guillaume AUPY was the Technical Program vice-chair of SC'17. This is the main conference of the field gathering more than $12,700$ attendees (practictionners, industrials and researchers) from 79 different nationalities. It is the first time someone from Inria is in charge of the technical program in 30 years of the conference. The Technical Program of SC17 comprises of 13 different elements (papers, workshops, panels, invited talks etc), for a total of 880 submissions from about 2900 unique individuals! 370 different volunteers participated in the review process of one or multiple elements of the Technical Program.

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.