RESEARCH CENTER

FIELD

Activity Report 2016

Section Highlights of the Team

Edition: 2017-08-25

ABS Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

In 2016, several achievements are worth noticing in three realms, namely in computer science, computational structural biology, and software.

4.1.1. Computer Science

► **Optimal transportation problems with connectivity constraints**
Reference: [21]

In a nutshell: Optimal transportation theory provides a rich framework to compare *measures*, both in the continuous and discrete settings. In this work, we study generalization of discrete transportation problems, when the supply and demand nodes are endowed with a graph structure; due to these constraints, our study focuses on transport plans respecting selected connectivity constrains. Our contributions encompass a formalization of these problems, as well as hardness results and heuristic algorithms.

Assessment: To the best of our knowledge, this work is the first one focusing on transport plans with connectivity constraints. One of the key applications targeted is the comparison of potential energy landscapes (PEL) in biophysics. Our algorithms provide a novel way to compare PEL, a topic overlooked so far.

► **Clustering stability revealed by matchings between clusters of clusters**
Reference: [22]

In a nutshell: Clustering is a fundamental problem in data science, yet, the variety of clustering methods and their sensitivity to parameters make clustering hard. This work provides a new tier of methods to compare two clusterings, by computing meta-clusters within each clustering– a meta-cluster is a group of clusters, together with a matching between these.

Assessment: Our methods will help assess the coherence between two clusterings, in two respects: by stressing the (lack of) stability of clustering while varying the parameters of a given algorithm, and by allowing a detailed comparisons of various algorithms.

4.1.2. Computational Structural Biology

► **Novel structural parameters of Ig-Ag complexes yield a quantitative description of interaction specificity and binding affinity**
Reference: [23]

In a nutshell: Understanding the specificity of antibodies for the targeted antigens, and predicting the affinity an antibody - antigen complexes is a central question in structural immunology. Using novel parameters acting as proxys for important biophysical quantities, we obtained affinity predictions of unprecedented accuracy, and were able to provide a quantitative explanation for the specific role of so-called *complementarity determining regions* – in particular CDR3 of heavy chains. See details in section 6.1.2 .

Assessment: Our affinity predictions are the most accurate known to date, and show that for certain classes of IG - Ag complexes, the affinity prediction problem may be solved from databases of high resolution crystal structures.

► **Energy landscapes and persistent minima**
Reference: [15]

In a nutshell: Potential energy landscapes (PEL) of molecular systems are complex high-dimensional height functions. In this work, we introduced several tools from graph theory, optimization, and computational topology, so as to identify prominent features of PEL – prosaically distinguishing the signal from the noise. See details in section 6.3.1 .

Assessment: Our work calls for important developments in two directions. The first one is concerned with the *calibration / learning* of features of PEL. The second one is the systematic comparison of force fields used in biophysics, as from current knowledge, deciding which force field is best for a given task or system is an open issue.

► **Hybridizing rapidly growing random trees and basin hopping yields an improved exploration of energy landscapes**
Reference: [18]

In a nutshell: We developed a novel exploration algorithm for high-dimensional non convex (potential) energy functions used in biophysics. Our algorithm exploits the ability of *basin hopping* to locate low-lying local minima, and that of *rapidly exploring random tree* to foster the exploration of yet unexplored regions. See details in section 6.3.2 .

Assessment: Our exploration algorithm outperform the two classical algorithms it is derived from. To strike a major impact, though, our exploration strategy needs to be complemented by enhanced thermodynamic sampling algorithms, able to bridge the gap between structures on the one hand, and thermodynamics / dynamics on the other hand.

4.1.3. Software

► **The Structural Bioinformatics Library**
Reference: [20]

In a nutshell: The SBL was released in 2015. In 2016, two important milestones were achieved, with the addition of several important packages, notably geared towards the generation and the analysis of conformational ensembles, and the publication of [20]–to appear in Bioinformatics.

Assessment: As outlined by the reviewers of [20], the SBL is to the best of our knowledge the first library proposing a coherent framework, in terms of algorithms, data structures and biophysical models, to tackle the most important problems in structural bioinformatics. Our paper presenting the SBL being in press as of December 2016, statistics on users and downloads will be reported in the 2017 activity report.

ACUMES Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

- P. Goatin got the *Trophée des Femmes en Or* for the “Smart City” category.

AIRSEA Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

In collaboration with M. Asch and M. Bocquet, M. Nodet published a book about Data Assimilation [30].

5.1.1. Awards

Jose R. Leon was granted by an International Inria Chair.

E. Arnaud was granted by a CRCT (Congé pour recherches ou conversions thématiques) by the CNU.

L. Debreu was awarded IMarEST Deny Medal for the best paper in journal of operational oceanography for year 2014.

ALICE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Geometry processing

Meshes composed of hexahedra (deformed cubes) are desirable for certain numerical simulations, they can improve both performances and precision. They are very difficult to generate. We developed in 2010 one of the first fully automatic algorithms that generates a "hex-dominant" hybrid mesh (top part of the image), with hexahedra and other elements (colored). This year, we made a quantum leap, and significantly reduced the number of non-hex elements (bottom part of the image). Our approach is based on an optimization of a direction field [11] and a global parameterization steered by the direction field [9].

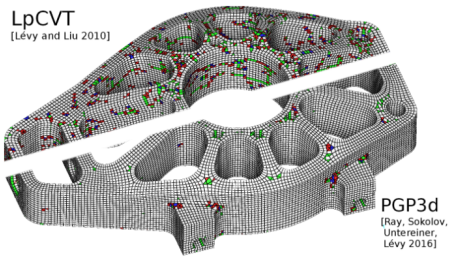


Figure 1. Improvements in hexahedral dominant remeshing.

5.1.2. Additive manufacturing

The advent of additive manufacturing enables the fabrication of shapes with unprecedented complexity, in particular embedding intricate micro-structures with details in the order of tens of microns. There is a strong interest in different fields for such structures, in medical science (prosthetics), mechanical engineering (strong but lightweight materials), art and design (aesthetics, material strength and flexibility). Unfortunately, we lack the software tools to model these structures efficiently. This year we made two significant advances in this area. We first proposed a novel methodology to create procedural micro-structures that exhibit good mechanical properties and can be fabricated [7]. As the definition of the micro-structure is procedural, they are not pre-computed. Instead their geometry is evaluated on the fly, slice after slice, during the additive manufacturing process. Yet, their elasticity can be progressively varied within the shape to align with geometric features. Our second contribution is a novel algorithm to synthesize intricate filigree patterns along a surface, from basic elements [5]. This is achieved by relaxing a strict geometric packing problem by to allow for partial overlaps between elements that preserve local geometric details. The shapes are optimized for strength during the synthesis.

ALPAGE Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

In 2016, Alpage has obtained several new national fundings: the team is the leader of a new ANR project (Parsiti), and a partner of a new ANR project (Profiterole) and of a new ANR-NSF project (MCM-NL).

ALPINES Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

5.1.1.1. SIAM Siag on Supercomputing Best Paper Prize 2016

for the most outstanding paper published in 2012-2015 in a journal in the field of high performance computing. Co-authors are J. Demmel, L. Grigori, M. Hoemmen, and J. Langou, for the paper Communication-Optimal Parallel and Sequential QR and LU Factorizations, published in SIAM Journal on Scientific Computing 2012. Citation of the jury: *This is a cornerstone paper in Numerical Linear Algebra and Parallel Processing that lays down both theoretical and practical algorithmic frameworks for communication-avoiding algorithms. The paper provides powerful insights and renews attention on communication reduction both of which will have long-lasting and practical impact in parallel and distributed computing.*

5.1.1.2. Bull-Joseph Fourier 1st Prize 2015 (15 000 euros)

for our work *Imaging of cerebrovascular accident through High Performance Computing* by V. Dolean, F. Hecht, P. Jolivet, F. Nataf and P-H. Tournier. This was the sixth edition of this competition which corresponds to the French "Gordon Bell Prize".

AMIB Project-Team (section vide)

ANGE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

While the theory and the numerics related to the nonlinear shallow water equations are extensively studied, the understanding of more complex models including dispersive ones is not achieved. Two PhD theses about these issues were defended in 2016 within the team (N. Aïssiouene and D. Kazerani). To go further, a collaboration with spanish collaborators from the university of Sevilla was launched with multiple trips in Spain and France resulting in a preprint [25]. The collaboration is expected to be made more formal in 2017.

Moreover, the team has been reinforced by two young engineers: J. Ledoux in the framework of the ANR project Hyflo-Eflu and F. Souillé. The latter recruitment has been allowed by the Inria ADT grant F2O ("Freshkiss to Others") and is aimed at easing the transfer of the Freshkiss code in cooperation with SciWorks Technologies.

ANJA Team (section vide)

ANTIQUE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

The team obtained several strong results published in excellent international conferences, with high theoretical and applied impact(see detailed results). Among the theoretical results we underline those presented in conferences like Principles of programming languages POPL 2016, and among the applied results we underline the release of MemCad, the first analyzer that can handle the analysis of various data structures.

AOSTE Project-Team (section vide)

APICS Project-Team (section vide)

ARAMIS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Stanley Durrleman's ERC Starting Grant "LEASP" has started.
- H2020 project EuroPOND, under societal challenge "Personalizing Health and Care" has started.
- ANR-NIH project NETBCI, under the "Collaborative Research in Computational Neuroscience" program (CRCNS) has started.
- The team has been awarded the ANR-NIH project HIPLAY7, under the "Collaborative Research in Computational Neuroscience" program (CRCNS)
- The team has been awarded the ANR project BRANDY, under the generic call programme "Vie, Sante et Bien-etre", Project duration: 2017-2020
- ARAMIS participates to the Human Brain Project (European Flagship).
- Anne Bertrand was awarded a one year Inria-APHP interface contract (i.e., "poste d'accueil"), allowing her to work half-time in the ARAMIS project team, from november 2016 to november 2017.
- Pietro Gori and Barbara Gris successfully defended their PhD.
- S. Durrleman has been appointed associate editor of IEEE Transactions on Medical Imaging (TMI).

ARIC Project-Team (section vide)

AROMATH Project-Team (section vide)

ASAP Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

Anne Marie Kermarrec has been named an ACM Fellow “for her contributions to large-scale distributed computing.”

George Giakkoupis was the General Chair of the 35th ACM SIGACT-SIGOPS Symposium on Principles of Distributed Computing (PODC 2016).

Michel Raynal renewed his appointment as an Adjunct Professor at the University of Hong Kong.

4.1.1. Awards

BEST PAPERS AWARDS :

[30] **IEEE IC2E'16**. S. DELBRUEL, D. FREY, F. TAÏANI.

[27] **The International Conference on Networked Systems NETYS**. N. CHILUKA, A.-M. KERMARREC, J. OLIVARES.

ASCLEPIOS Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

Marco Lorenzi has been recruited as Chargé de Recherche in the Asclepios team from December 2016.

4.1.1. Awards

- Nina Miolane received the l'Oréal-UNESCO Fellowship for Women In Science. She counts among the 30 awardees who have been selected by an independent jury to stress the excellence and originality of their scientific research and their dedication to share their knowledge in the broader society.
- Shuman Jia received the Best Challenge Paper Award during the 7th international workshop on Statistical Atlases and Computational Modeling of the Heart (STACOM), held in Conjunction with MICCAI 2016 in Athens, Greece.

BEST PAPERS AWARDS :
[39] **7th International Statistical Atlases and Computational Modeling of the Heart (STACOM) Workshop, Held in Conjunction with MICCAI 2016**. S. JIA, L. CADOUR, H. COCHET, M. SERMESANT.

ASCOLA Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

This year the team has produced major results in the domains of the foundations of computer science as well as capacity management for large-scale distributed software systems.

Concerning the foundations of computer science, we have presented new results on the provably correct execution of programs that are only partially typed [22] and generalized the use of dependent types with side effects [26].

As to distributed systems, we have introduced a new cloud model that provides QoS-levels and SLA as first-class citizens of cloud-based systems [19]. Furthermore, we have provided new mechanisms for the privacy-preserving storage of data of a user over clouds managed by different cloud providers [30].

ASPI Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Frédéric Cérou and Arnaud Guyader have received the prize of the best recent paper published in the journal *Annales de l'Institut Henri Poincaré, Probabilités et Statistiques* for their joint paper [3] in collaboration with Gérard Biau (université Pierre et Marie Curie). This paper analyzes ABC (approximate Bayesian computation) — a family of computational techniques which offer an almost automated solution in situations where evaluation of the likelihood is computationally prohibitive, or whenever suitable likelihoods are not available — from the point of view of k—nearest neighbor theory and it explores the statistical properties of its outputs. The paper discusses in particular some asymptotic features of the genuine conditional density estimate associated with ABC, which is an interesting hybrid between a k–nearest neighbor and a kernel method.

ATHENA Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

R. Deriche and the ATHENA team has been awarded by an ERC Advanced Grant from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation program (ERC AdG agreement No 694665 "Computational Brain Connectivity Mapping" started on Sept. 1st, 2016.)

Guillermo Guallardo, PhD has been awarded by a Merit Abstract Award by the 2016 OHBM Annual Meeting in Geneva, Switzerland for his work entitled *Efficient Population-Representative Whole-Cortex Parcellation Based on Tractography* [34].

5.1.2. Press coverage

Brain-Computer Interfaces developped in Athena attracted attention of the media, at regional and national levels: Nice Matin, Le Dauphiné Libéré and Le Figaro Santé have published articles about our translational research on the P300 speller. This system enables severely disabled patients, who are deprived of voluntary motor control, to communicate by using only their visual attention.

AVALON Project-Team (section vide)

AVIZ Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

We had a number of highlights this year:

- Aviz researchers contributed 35 publications this year. Amongst these 6 papers were presented at IEEE VIS, the largest international Visualizations and Visual Analytics conference. One full paper was presented at UIST, one the most prestigious international conference on human computer interaction;
- Aviz researchers organized two workshops at international conferences (IEEE VIS);
- Three awards were won by Aviz researchers for papers (see below);
- We welcomed four international students to our lab for research visits;
- Aviz researchers taught four lectures at various French and international universities.

5.1.1. Awards

[8]
E. DIMARA, P. DRAGICEVIC, A. BEZERIANOS.*The Attraction Effect in Information Visualization*, in "IEEE Transactions on Visualization and Computer Graphics", 2017, vol. 23, no 1 [DOI : 10.1109/TVCG.2016.2598594], https://hal.inria.fr/hal-01355750
BEST PAPERS AWARDS :
[24] **Proceedings of the Symposium on User Interface Software and Technology (UIST)**. M. LE GOC, L. H. KIM, A. PARSAEI, J.-D. FEKETE, P. DRAGICEVIC, S. FOLLMER.
[25] **IEEE VIS 2016**. S. K. BADAM, C. KINKELDEY, P. ISENBERG.

AYIN Team

4. Highlights of the Year

4.1. Highlights of the Year

- Josiane Zerubia is IEEE Signal Processing Society Distinguished Lecturer for 2016 and 2017, see (http://signalprocessingsociety.org/newsletter/2015/11/sps-announces-2016-class-of-distinguished-lecturers/)
- Josiane Zerubia received the Excellency Prize of UCA (Université Cote d'Azur) for her outstanding research work in December 2016.
- Nazre Batool who was an Inria post-doc in AYIN till May 2015 received the IEEE R8 Women in Engineering Clementina Saduwa 2016 award, see (http://www.femmesetsciences.fr/actualites/nazre-batool-prix-clementina-saduwa-2016/)
- Josiane Zerubia, in collaboration with Gabriele Moser from University of Genoa (Italy), edited a book of more than 400 pages on mathematical models for remotely sensed image processing [11] which was submitted to Springer Verlag in December 2016 and will be published early 2017. They also contributed to two chapters of this book.

BEAGLE Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

EvoMove

We completed the implementation of the EvoMove system, an evolving music generation system based on performer moves. The moves are not predefined, they are identified by an evolutionary subspace clustering algorithm that builds on-the-fly move categories. Such a category is created when similar moves are repeated, but it remains flexible in the sense that it can adapt to gradual changes of the moves. A category can also be forgotten when the corresponding moves do not occur any longer. We run working sessions with dancers and record parts of these performances on videos. The first prototype of EvoMove has been tested with the Anou Skan company (https://www.youtube.com/channel/UCoyfXJx_izpQZi6hD8w5M3A). The system immediately convinced the dancers of its interest and we are now working on the creation of a short play with Claire Lurin, an INSA-Lyon student who is also a semi-professional dancer.

ECAL

The Beagle team was chosen by the board of the ISAL (International Society For Artificial Life) to organize ECAL 2017, the 14th European Conference on Artificial Life. ECAL is the offical conference of the ISAL on odd years. Organizing ECAL 2017 will confirm the Beagle team as a major player in the international artificial life community and as the domain leader in France.

BIGS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

BIGS team has organised a two-days workshop "Rencontres des équipes Inria travaillant sur le cancer" that took place Paris in March. 10 inria teams were present. The program is available on https://team.inria.fr/bigs/workshopcancer/.

BIOCORE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- The question of how many and how frequently natural enemies should be introduced into crops to most efficiently fight a pest species is an important issue of integrated pest management, which depends on the pest-natural enemies interaction. Since some natural enemies may exhibit positive predator density dependence in the predation interaction, we studied its impact on the optimal biological control introduction strategies [15].
- Optimal allocation of resources in a bacterium. We studied by techniques of optimal control the optimal allocation between metabolism and gene expression during growth of bacteria, in collaboration with Inria IBIS project-team. We showed that a good suboptimal control solution could be implemented in the cell by ppGpp (a small molecule involved in the regulation of ribosomes) [23].

BIOVISION Team (section vide)

BIPOP Project-Team (section vide)

BONSAI Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

The software SortMeRNA, developed by the team, has reached the number of 100 labs worldwide that have been using it to analyze their sequencing data. SortMeRNA is able to deal with large metagenomics projects with multiple applications in health (gut microbiome,...), environment (sea, lakes, soil,...), biotechnologies (bio-films,...). The first version was released at the end of 2012, and it is still under active maintenance.

CAGIRE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

From Cagire to ... Cagire !

Last April 2016, after near five years of existence and a 1-year preparation/evaluation process of the new project, the common team Cagire (**C**omputational **A**pproximation with discontinuous **G**alerk**I**n methods and compa**R**ison with **E**xperiments) died and was reborn as the common **project** team Cagire (**C**omputational **AG**ility for internal flows s**I**mulations and compa**R**isons with **E**xperiments) with the much broader scope presented above.

A first step towards the dissemination of the AeroSol library

A deposit procedure of the AeroSol library (around 78000 lines of C++) with APP [0] has been finalized in 2016. This will protect the library authors' rights and will open the possibility of disseminating the library in a sound way.

Launching of a long-term collaboration with a new industrial partner, PSA

In January 2016, we have been contacted by the R & D department of the PSA Group (Peugeot Citroën Automobile SA) in order to elaborate a long-term, 10-year project on the modelling and simulation of the turbulent flow in the under-hood space of road vehicles, in the framework of their *Full Digital 2025 Ambition*, i.e, their plan to switch to a design of future vehicles entirely based on simulation. In order to overcome the technological barrier of the prediction of the natural convection regime, a long-term collaboration program has been established, starting with an internship (Saad Jameel), defended in September 2016, a CIFRE PhD (same student), going to start in February 2017, and the deposit of the ANR PRCE project MONACO-2025, coordinated by R. Manceau, involving the institute PPrime of Poitiers, PSA and EDF.

[0] http://www.app.asso.fr/en/welcome.html

CAIRN Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Our work on accuracy evaluation and optimisation for fixed point arithmetic was presented during a tutorial "Fixed-point refinement, a guaranteed approach towards energy efficient computing" at HiPEAC Conference in January 2016 [60].
Members of CAIRN got six papers accepted at IEEE/ACM Design Automation and Test in Europe for 2017, one of the major events in design automation.

CAMIN Team

5. Highlights of the Year

5.1. Highlights of the Year

International Functional Electrical Stimulation Society Conference organization

In 2016, CAMIN organized the 20th International Functional Electrical Stimulation Society Conference. 135 participants attended the event. Papers are referenced in Pubmed and published in European Journal of Translationnal Myology. A special issue with a selection of best articles will be published in 2017 in Artificial Organs Journal. http://ifess2016.inria.fr/

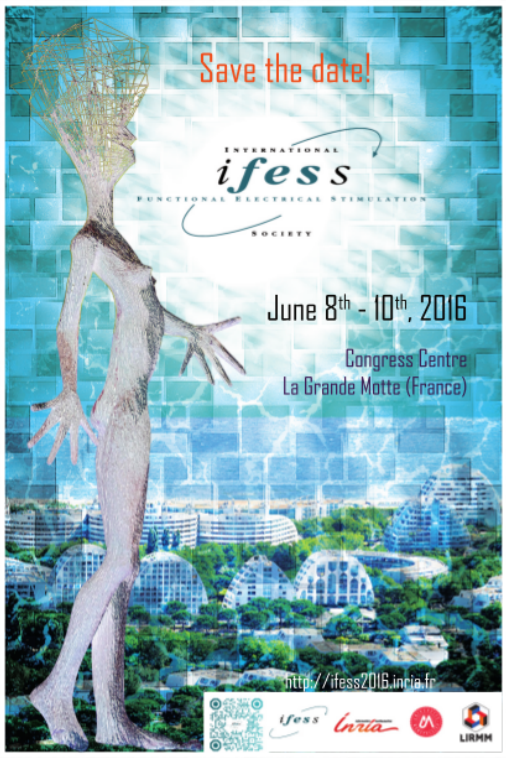


Figure 3. Flyer of IFESS 2016 conference

Participation into Cybathlon competition

We have participated in the first international competition Cybathlon held in Kloten, Switzerland in October 2016. After more than one year of physical and technical preparation, our team, Freewheels, was present with one complete paraplegic pilot in the FES cycling discipline. http://freewheels.inria.fr/

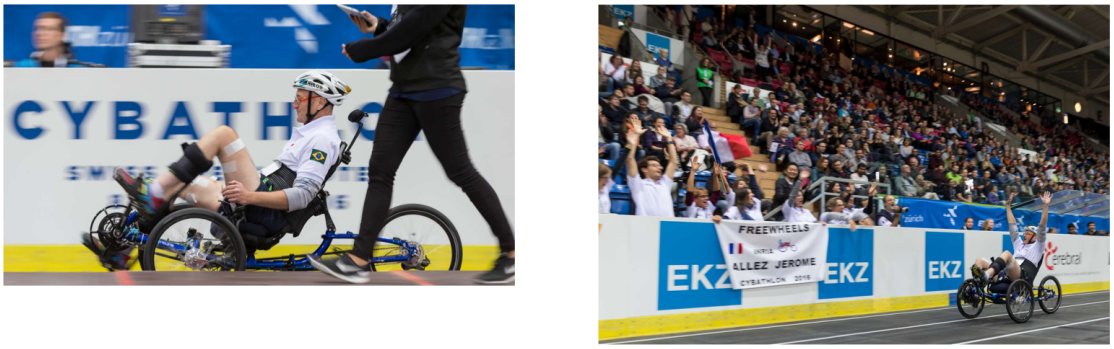


Figure 4. Freewheels team at Cybathlon 2016

CAMUS Team

5. Highlights of the Year

5.1. Highlights of the Year

Arthur Charguéraud, Inria Research Scientist, has joined the team in October 2016.

The first release of the speculative polyhedral loop parallelizer *Apollo*[0] has been published under the BSD 3-Clause Open Source License.

5.1.1. Awards

BEST PAPERS AWARDS :
[13] **Euro-Par 2016**. J. M. MARTINEZ CAAMAÑO, W. WOLFF, P. CLAUSS.

[0] http://apollo.gforge.inria.fr

CAPSID Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

A figure from our article in the *Journal of Applied Crystallography* [19] was used to illustrate the front cover of the February issue of the journal.

CARAMBA Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

The Caramba project-team was created on January 1st, 2016!

In October 2016, Pierrick Gaudry and Emmanuel Thomé, together with colleagues from the University of Pennsylvania (USA), have performed a discrete logarithm computation of a 1024-bit trapdoored prime [18].

CARDAMOM Project-Team (section vide)

CARMEN Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Events

On 4 November 2016 the new building of the IHU Liryc was officially opened in the presence of representatives from the municipal, departmental, regional, and national authorities.

On 9 December 2016 A. Davidović defended her thesis Multiscale Mathematical Modeling of Structural Heterogeneities in Cardiac Electrophysiology.

5.1.2. Recruitments

M. Potse, whose work had been funded by IHU Liryc since 2013, has become a full-time member of the Carmen team and has won an Inria Advanced Research Position in June 2016. He will continue his numerical studies on cardiac sudden-death syndromes and atrial fibrillation and is developing a new project on the application of electrocardiographic inverse methods in the catheterization laboratory.

We recruited the engineer P. Migerditichan; she started working in November 2016 on a project named EPICARDial electrical signals VIZualisation (EPICARD-VIZ). The aim of this project is to build a software solution for the electrocardiographic inverse problem, coded in the MUSIC platform. The goal of the project is twofold: First, we aim at building a semi-automatic functionality that allows to obtain meshes of the epicardium, torso, lungs, liver, and skeletal muscle with minimal human interaction. Second, our aim is to include a dense linear algebra library and to construct a computational framework in which we will be able to compare different methods of solving the inverse problem.

After the completion of her PhD thesis A. Davidović was hired as an Engineer, granted by the ANR HR-CEM project. She continues her work on multiscale modelling of heterogeneities in cardiac tissue. She is going to use the experimental high-resolution MRI data on animal and human hearts that are provided by the imaging team of IHU Liryc. By means of image analysis and numerical simulations she is going to study the effects of fibrotic, fatty, and other kinds of tissue on AP propagation.

CARTE Team

5. Highlights of the Year

5.1. Highlights of the Year

The Marie Curie RISE project *Computing with Infinite Data* coordinated by Dieter Spreen (Siegen University), in which Mathieu Hoyrup is participating, has been accepted. It will start in April 2017.

CASCADE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Conferences

- Hoeteck Wee is one of the invited speakers at Asiacrypt 2016.
- Michel Abdalla is one of the invited speakers at ICISC 2016.

5.1.2. Awards

Romain Gay and Hoeteck Wee, together with Dennis Hofheinz and Eike Kiltz, received the Best Paper Award at Eurocrypt 2016 .
BEST PAPERS AWARDS :
[40] **Advances in Cryptology – EUROCRYPT 2016**. R. GAY, D. HOFHEINZ, E. KILTZ, H. WEE.

CASTOR Project-Team (section vide)

CEDAR Team

5. Highlights of the Year

5.1. Highlights of the Year

ERC Proposal Accepted

Y. Diao's ERC Consolidator proposal "Charting a New Horizon of Big and Fast Data Analysis through Integrated Algorithm Design" has been accepted by the EU.

Awards

- A team of five including the team's PhD student Tien Duc Cao has won the first place at the Start-up Week-End in Artificial Intelligence (SWAI) in November 2016 (https://twitter.com/i/moments/796004617410711552, http://swai.fr/).
- Šejla Čebirić has been awarded the Google Anita Borg Scholarship.
- The paper "On the Complexity of Evaluating Regular Path Queries over Linear Existential Rules." by M. Bienvenu and M. Thomazo received the best paper award at the RR'16 conference .

BEST PAPERS AWARDS :

[3] **10th International Conference on Web Reasoning and Rule Systems**. M. BIENVENU, M. THOMAZO.

CELTIQUE Project-Team (section vide)

CHROMA Team

5. Highlights of the Year

5.1. Highlights of the Year

- Laetitia Matignon, Associate Professor at Université de Lyon and LIRIS Lab has obtained an Inria delegation to join the Chroma team (half-time).
- Stephane d'Alu, research engineer at CITI lab., has joinded the team for one year, half-time.
- Christian Laugier is a co-author with A. Broggi, A. Zelinski and U. Ozguner, of the chapter "Intelligent Vehicles" of the 2nd edition of the "Hanbook of Robotics" edited by B. Sicilano and O. Khatib and published in July 2016.
- A new collaboration has been built with the team of Gabriella Czibula, from University of Babes-Bolyai in Cluj-Napoca, Romania. We obtained a bilateral french-romanian PHC project, called DRONEM, to support the collaboration for the period 2017-2018.
- A new collaboration has been built with the Volvo Group in Lyon, through the co-supervision of the PhD thesis of Guillaume Bono funded by the INSA-Volvo Chair.
- A new collaboration has been built with the GIPSA Lab in Grenoble and the team of Gerard Bailly (CNRS), through the co-supervision of the PhD thesis of Remi Cambuzat funded by the Region.
- The Chroma team has been reconducted for 2017 as a Nvidia CUDA lab, for his work related to "embedded perception and autonomous vehicles".
- A new Research contract on "robust sensor fusion involving vision data" has been signed with Toyota Motor Europe in 2016. The results have been patented by Inria and Toyota.
- The results obtained in the scope of the Research contract on "autonomous driving" have been patented by Inria, Insa and Toyota.
- Acquisition of a Pepper robot, funded by INSA de Lyon and CITI-Inria lab., and acquisition of 4 Crazyflies robots, funded by the CITI lab.

5.1.1. Awards

- Christian Laugier was awarded IROS Fellow at IROS 2016 and recieved the IROS Distinguished Award citation for his Outstanding Services to IROS Advisory/Steering Committee and IROS Conferences.

CIDRE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

Mounir Assaf, a former PhD student, has received the "prix de thèse du GDR GPL" in June 2016. His PhD thesis is entitled "évaluation des fuites d'information dans les logiciels critiques" and has been defended in 2015.

Emmanuelle Anceaume has received the Most Prolific Author Award during the NCA conference.

BEST PAPERS AWARDS :

[28] **9th International Conference on Security of Information and Networks (SIN 2016)**. D. SUBRAMANIAN, G. HIET, C. BIDAN.

[24] **Symposium on Network Computing and Applications**. Y. MOCQUARD, B. SERICOLA, S. ROBERT, E. ANCEAUME.

CLIME Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

Inria and Paris City were awarded a Décibel d'Argent 2016 in research category for the mobile application Ambiciti. The award was attributed by the Conseil National du Bruit, which depends on the Ministry of Ecology, Sustainable Development and Energy, and is a national organization in charge of noise. The selection committee pointed out the Ambiciti articulation between research, citizen involvement, city or government actions and the operational development of a rich and perennial mobile application.

COAST Project-Team (section vide)

COATI Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

David Coudert and Nathann Cohen (LRI) won the Flinders Hamiltonian Cycle Problem (FHCP) Challenge 2016 (http://fhcp.edu.au/fhcpcs).

Fatima Zahra Moataz, former PhD student of COATI, is the recipient of an accessit to the PhD prize Graphes "Charles Delorme" 2016 for her PhD thesis entitled "Towards Efficient and Fault-Tolerant Optical Networks: Complexity and Algorithms".

COFFEE Project-Team (section vide)

COMETE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Notable New Projects and Contracts

- New ANR project REPAS: Reliable and Privacy-Aware Software Systems via Bisimulation Metrics (Section 9.3.4.1)
- New industrial contract with Renault: Protection techniques for location data (Section 8.1.1)

COMMANDS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

We started at the beginning of 2016 an Innovation Lab (Ilab) 'OSCAR', jointly with the startup Safety Line. The subject of the Ilab is the design of algorithmic tools for the (i) identification of aircraft dynamics, based on flight data recorders, and (ii) the computation of energy efficient flight trajectories.

COMPSYS Team

5. Highlights of the Year

5.1. Highlights of the Year

Scientific Results and Dissemination

Despite the approaching end of Compsys, we continued the objectives we fixed for Compsys III, i.e., pushing static compilation beyond its present limits, both in terms of techniques and applications. Our most important efforts in 2016 were to extend static analysis from sequential codes to parallel specifications and languages, to develop polynomial techniques, and to increase inter-disciplinary collaborations and dissemination towards HPC users and their applications. The most important results in 2016 are the following:

- **Publications** Well recognized in the polyhedral community, we got three papers at IMPACT'16, the central event of this community, one paper at the main compiler conference (CC'16), and a last one in the field of FPGA, which remains an important target for polyhedral optimizations. See Sections 7.1 to 7.7 for more details.
- **Interdisciplinary spring school** With colleagues from HPC numerical simulation, we organized a very successful inter-disciplinary event in May 2016, to bridge the gap between polyhedral compilation and HPC users. See details in Section 10.1 .
- **Move towards HPC users** In addition to the spring school we organized, we increased our activity towards HPC users and their applications through the supervision of the internship of J. Versaci (quantum physics), the reviewing of T. Gasc's PhD thesis (fluid dynamics), and the regular contacts with the LMGC lab (mechanics).
- **PhD theses** The end of Compsys coincided also with the end of two PhD theses, the PhD thesis of Guillaume Iooss [16] and the PhD thesis of Alexandre Isoard [17], see Section 10.2.2 .
- **Final evaluation** The team was evaluated in March 2016, this was also its final evaluation.

Final Evaluation and End of Compsys

Compsys has been created in 2002 as an Inria team, then in 2004 as an Inria project-team, and evaluated by Inria first in 2007, then in 2012. It was evaluated again in March 2016, which was its final evaluation because an Inria project-team is limited to 12 years. The construction of a new project was planned in early 2015, following the shift in the research directions that started in the second half of Compsys III. A few tentative research directions were:

- Shift the application domain from embedded systems to high performance computing (HPC) but at small scale (desktop HPC: FPGA, GPU, multicores). In fact, the two ecosystems are nowadays slowly converging.
- A stronger attention to real HPC users and real HPC applications may lead to better programming models ("putting the programmer in the loop").
- Design new models of programs. The polynomial model is but an example.
- Explore the synergy between parallel programming and program verification and certification; in particular, import approximation methods from one field to the other. Abstract interpretation is a case in point.

However, while its field of expertise, compilation for parallel and heterogeneous systems, is still of crucial importance, the unexpected departure in Sep. 2015 of two of its staff members made this future impossible. We nevertheless continued in 2016, in particular to present our activities in this last evaluation, until the three last members had to split in three different cities (Lyon, Paris, Rennes). We report here some of the comments made by the external reviewers that, we think, summarize well some aspects of our efforts, successes, and difficulties during 15 years:

- *Compsys established and matured the polyhedral optimization approach, which is the state of the art for locality and parallelism optimization in optimizing compilers. The project has had world-wide impact.*
- *We strongly recommend that the members of the team are accommodated in Camus, Cairn, Parkas, or another complementary Inria team, irrespective of the geographical location. Otherwise, Inria will lose one of its peaks of research excellence in Computer Science.*
- *This team is a prime example where Inria requirements on teams are damaging science and collaboration.*
- *This team has produced many impactful results and is considered as the Polyhedral center of excellence. It is globally recognized for its research in both front-end (polyhedral optimizations) and back-end (graph optimizations) compiler optimization techniques integrating elegant foundational theory with real implementation on various architectures (multi-core, FPGAs, DSP, GPU etc.).*
- *In back-end optimizations, the team had developed the state-of-the-art SSA and decoupled register allocation techniques that are important to achieving peak performance.*
- *They have internationally visible and impactful research in compilers, technology transfer to companies through collaborations and through start-ups. They raised the global awareness of polyhedral analysis through creation of workshops, summer schools etc., essentially reviving interest in the topic about a decade ago, and finally educating next-generation of researchers in this area, who are now contributing to both academic and industrial research landscape in France and beyond.*

- *The start-up company (XtremLogic on HLS) is an excellent concrete evidence of technology transfer from the team. [...] In the future, a more careful analysis of the trade-off between technology transfer and academic research is necessary for small project teams so that a promising research direction does not get jeopardized in Inria.*
- *The Compsys team has truly achieved research excellence in compilation techniques. Unfortunately, the future of the team remains uncertain due to administrative policies. Inria should enable the team to continue with their research strengths in polyhedral analysis and graph-theory based SSA-type optimizations.*

CONVECS Project-Team (section vide)

CORSE Project-Team (section vide)

CQFD Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Publication of the book: *Stochastic Processes. From Applications to Theory* written by P. Del Moral and S. Penev, CRC Press, 1290 pages, Jan 2017.

Pierre del Moral has been invited to the IMS World Congress in Toronto to give a Medallion lectures in May 2016.

CTRL-A Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Outstanding publications

Results from our work in the ANR project Ctrl Green (see Section 7.2.1) were published in IEEE Transactions on Software Engineering [16].

Our work on Control of Autonomic Parallelism Adaptation on Software Transactional Memory [20] was nominated in the short list for best papers at the International Conference on High Performance Computing & Simulation (HPCS 2016), Innsbruck, Austria, July 2016.

5.1.2. Community

We have been invited to participate to the organization of events, which highlight our active presence in the scientific life in the two domains which we are bridging :

- autonomic computing:

  Eric Rutten is PC co-chair of the International Workshop on Autonomic High Performance Computing (AHPC 2016) (http://hpcs2016.cisedu.info/2-conference/workshops—hpcs2016/workshop08-ahpc) as part of the International Conference on High Performance Computing & Simulation (HPCS 2016) (http://hpcs2016.cisedu.info or http://cisedu.us/rp/hpcs16), July 18 - July 22, 2016, The University of Innsbruck, Innsbruck, Austria ; and PC member of the two major conferences on the topic : the 13th IEEE International Conference on Autonomic Computing (ICAC 2016) Wuerzburg, Germany, July 19-22, 2016 (http://icac2016.uni-wuerzburg.de) and the 4th International Conference on Cloud and Autonomic Computing (ICCAC 2016), Augsburg, Germany on September 12-16, 2016 (http://iccac2016.se.rit.edu), Part of FAS* - Foundation and Applications of Self* Computing Conferences, Collocated with the IEEE Self-Adaptive and Self-Organizing System Conference.

  He is PC member of the 2017 edition of these two conferences as well.

  He is invited editor of Cluster Computing, The Journal of Networks, Software Tools and Applications (Springer), foe the special issue of ICCAC 2015 Best Papers (http://link.springer.com/journal/10586/19/2/page/1).

  He is PC member for the SEfSAS Book 3 (Software Engineering for Self-Adaptive Systems: Assurances) Volume 3 to be published by Springer LNCS as nr. 9640 in 2017.

  Gwenaël Delaval is PC member of the International Workshop on Autonomic High Performance Computing (AHPC 2016).

- control:

  Eric Rutten is organizer of an Open Invited Track on "Control for Computing Systems" at the 20th IFAC World Congress, to be held in Toulouse, July 9-14, 2017, (https://www.ifac2017.org/OIT#geht5).

  He is PC member of the 13th International Workshop on Discrete Event Systems (WODES 2016), Xi'an, China on May 30 - June 1, 2016 (http://wodes2016.diee.unica.it).

  He is on the IFAC Technical Committee 1.3 on Discrete Event and Hybrid Systems, (http://tc.ifac-control.org/1/3/) and on the IEEE Control Systems Society Discrete Event Systems Technical Committee (http://discrete-event-systems.ieeecss.org).

5.1.3. Invited talk

Eric Rutten was invited to give a talk at the 9th Cloud Control Workshop (by invitation only), Stockholm, June 27-29 2016 (http://cloudresearch.org/workshops/9th) and at the séminaire LIP / Avalon, 16 février 2016, ENS Lyon (https://intranet.inria.fr/Actualite/SEMINAIRE-16-02-16-ERIC-RUTTEN-ENS-DE-LYON).

DAHU Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Awards

Luc Segoufin together with Mikolaj Bojanczyk, Claire David, Anca Muscholl, and Thomas Schwentick obtained the ACM Alberto O. Mendelzon PODS Test of Time Award in 2016.

DANTE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Network Science Semester

Dante organised in 2016 a full semester on Network Science (https://project.inria.fr/netspringlyon/) in conjunction with the SiSyPhe team at ENS de Lyon, the Centre de Physique Théorique of Marseille, the Excellence Laboratory MILYON and the Institute of Scientific Interchange of Turino. This program intends to cover both the basics of and recent advances in Network Science. These questions, which are in the focus of contemporary network science, set the scope of the actual proposal where we aim to bring together world-known experts from the fields of mathematics, physics, signal processing, computer science, social science, epidemiology and linguistic to discuss and enhance our understanding about the interaction between the structure, evolution, and coupled dynamical processes of complex networks. The semester gathered 2 workshops and 1 conference. during the two workshop, 14 invited speakers spend time within Dante in short or long visit. Members of Dante also organised in June Socionet (http://www.socionet2016.fr) for young researchers and focus on the interdisciplinary meeting on social network: description, data, modelling, interpretation. It was a great success with a Datathon organised by the PhD student and PostDoc of DANTE.

5.1.2. Frutfull collaboration with GranData (http://www.grandata.com/)

Grandata integrates first-party and telco partner data to understand key market trends, predict customer behaviour, and deliver novel business results. We have published several papers [12], [41], [36], [11], [10] in collaboration with them on the socioeconomic correlations and stratification in social-communication networks, on the impact of university admission on freshmen' social egocentric network, on the correlations of consumption patterns in social-economic networks but also to validate DTN like protocols by taking benefits of the density and locality of urban communication patterns.

DATAMOVE Team (section vide)

DATASHAPE Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

Jean-Daniel Boissonnat has been elected a professor at the Collège de France, on the Chair Informatics and Computational Sciences for the academic year 2016-2017.

5.1.2. Books

Publication of a book [29], providing a self-contained presentation of the theory of persistence modules over the real line, the objects that are at the heart of the field of TDA.

DEDUCTEAM Team (section vide)

DEFI Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- L. Audibert obtained the PhD prize Paul CASEAU of EDF.
- Grégoire Allaire was appointed as president of the scientifique board of IFP Energies Nouvelles.
- Grégoire Allaire broke 15 bones in a climbing accident on the 19th of July, 2016. It takes a long time to fully recover...

DEFROST Team

5. Highlights of the Year

5.1. Highlights of the Year

New Research scientist

Olivier Goury was selected to join the team as new Inria research scientist.

Robosoft Grand Challenge

The team participated in the Robosoft Week in Livorno, with a workshop on simulation of soft robots held by Christian Duriez, Thor Bieze and Eulalie Coevoet. In addition, 2 prototypes were presented to the Robosoft Grand Challenge, reaching the 4th place of the competition.

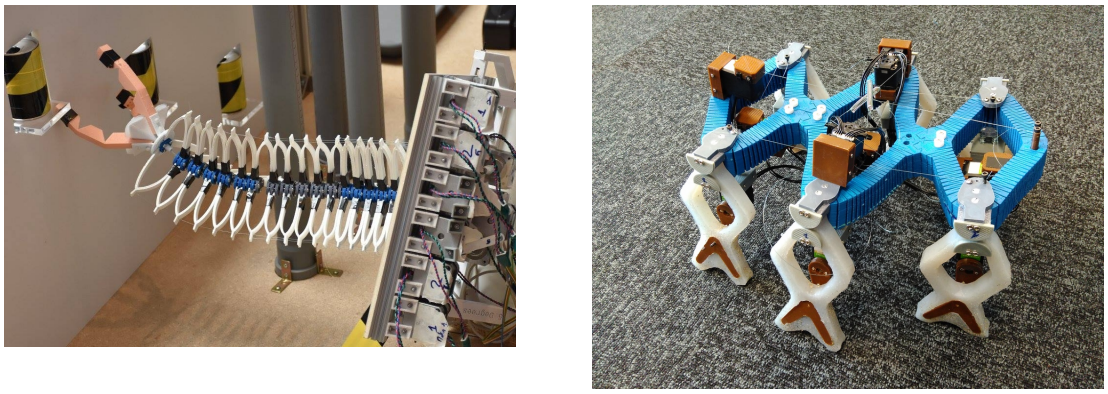


Figure 2. (a) EchelonIII (b) SOFIA

ERC evaluation grade A

The project COMOROS submitted for ERC Consolidator "fully met the ERC's excellence criterion" and evaluated as grade A. Unfortunately, it could not be funded, given the available budgetary resources of ERC for the call. But the region Haut-De-France should be able to finance a part of the project during the 3 coming years thanks to the FEDER funds.

DIANA Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

The R^2lab testbed, part of the national FIT facility, was inaugurated on the SophiaTech campus this year. This new anechoic chamber can be used to remotely perform reproducible wireless network experimentation (5G/software-defined radio). The live public demonstration at the inauguration presented a 4G network being deployed remotely in merely three minutes. For more details see http://r2lab.inria.fr/news.md.

The soTweet project studying the impact Twitter on Media web sites popularity has triggered worldwide media coverage (*Washington Post, Les échos, Le Vif, El Diaro, BFM TV*, etc.) Details and links are in http://www-sop.inria.fr/members/Arnaud.Legout/Projects/sotweet.html. The results are published in [18].

This year witnessed the publication of three RFCs (7834 [36], 7835 [35] and 7927 [31]). These RFCs are the result of a long term contribution by Damien Saucez to the activities on the LISP protocol and in parallel on Information Centric Networking at the IETF and IRTF.

A third session of the Python MOOC by Arnaud Legout and Thierry Parmentelat has been programmed in 2016 and it was also a very big success: 12954 persons registered to the course, out of them 1603 qualified for the final attestation of achievement. This MOOC is adopted by several universities and engineering schools: UPMC L3 program (200 students), first year in CentralSupelec (529 students), SIO Master in CentralParis (16 students), first year of ESISAR school from the Institut Polytechnique de Grenoble group (67 students).

DICE Team (section vide)

DIONYSOS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Pierre L'Ecuyer received the 2016 ACM SIGSIM Distinguished Contributions Award.
BEST PAPERS AWARDS :
[75] **Symposium on Network Computing and Applications**. Y. MOCQUARD, B. SERICOLA, S. ROBERT, E. ANCEAUME.
[49] **International Conference on Modeling, Analysis and Simulation of Wireless and Mobile Systems (MSWIM 2016)**. M. BOUZOUITA, Y. HADJADJ-AOUL, N. ZANGAR, G. RUBINO, S. TABBANE.

DISCO Project-Team (section vide)

DIVERSE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

H2020 project accepted in the call ICT-10-2016 'Software Technologies', as coordinator.

The book "Engineering Modeling Languages" has been published by CRC Press. This book, co-authored by Benoit Combemale, Robert B. France, Jean-Marc Jézéquel, Bernhard Rumpe, Didier Vojtisek and Jim Steel, is the result of our respective expertise in model-driven engineering and software language engineering.

5.1.1. Awards

Silver Medal of the CNRS for Jean-Marc Jézéquel.

Second position for the ACM Student Research Competition: Thomas Degueule.

DOLPHIN Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Patent with the company Beckman: the invention relates to the handling of samples of biological material. In one aspect, the invention relates to optimization techniques for aliquoting such biological samples in a manner which accounts for various conditions and requirements as they may exist when the samples are to be processed.

DRACULA Project-Team (section vide)

DREAMPAL Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

2016 is the last year of Dreampal's existence as an Inria project-team. Due to different scientific objectives, three of the members (S. Meftali, J.L. Dekeyser, P. Marquet) will create a group within the Cristal laboratory, while the team leader V. Rusu will collaborate with the 2xs team within Cristal. Frédéric Guyomarch joined the L2EP laboratory, and external collaborator Rabie Ben Atitallah continues his activity in the LAMIH laboratory in Valenciennes.

This activity report has been written by the team leader, based on the information available to him at the time of its writing. Any activity, e.g., by other team members, not reflected in the report, is only missing because of lack of input from the people concerned.

DYLISS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

The first main novelty in 2016 is the release of our first methods and tools based on semantic web technologies. These methods enable the pre-processing of heterogeneous data prior to their integration in the toolboxes developped by the team. Methods for the transparent integration and querying of heterogeneous data (AskOmics) as well as the user-friendly tracable reconstruction of metabolic networks (PADmet package) have been developped in collaboration with our main partners (INRA Rennes, University of Chile, Station biologique de Roscoff) to facilitate the comparison of phenotypes accross several species or several strains.

DYOGENE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

F. Baccelli received a Honorary Doctorate of Heriot-Watt University. The graduation took place on November 17, 2016, in Edinburgh, United Kingdom.

ECUADOR Project-Team (section vide)

ERABLE Project-Team (section vide)

EVA Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Awards

- Prof. Steven Glaser (UC Berkeley) and **Thomas Watteyne** recipients of the France-Berkeley Fund award for the project "SHRIMP: Smart Harbor Implementation", August 2016.
- Keoma Brun-Laguna and **Thomas Watteyne**, together with Ana Laura Diedrichs, Javier Emilio Chaar, Diego Dujovne, Juan Carlos Taffernaberry, Gustavo Mercado. Runner up IEEE SECON 2016 Best Demo Award with "A Demo of the PEACH IoT-based Frost Event Prediction System for Precision Agriculture", London, UK, 28 June 2016.
- Remy Leone and **Thomas Watteyne**. Recipient Google IoT Technology Research Award on "6TiSCH and WiFi coexistence with OpenWSN", March 2016.
- Tengfei Chang and **Thomas Watteyne**, together with Pedro Henrique Gomes, Pradipta Gosh, Bhaskar Krishnamachari. EWSN dependability competition 4th place with project "Reliability through Time-Slotted Channel Hopping and Flooding-based Routing", 16 February 2016.

Meeting & Seminars

Organization of Workshops and Conferences

- ***PEMWN 2016*** international conference on Performance Evaluation and modeling in Wired and wireless Networks, co-chaired by Leila Saidane and **Pascale Minet** and Farouk Kamoun , held in Paris, France, November 2016. Pascale Minet was general co-chair with Leila Saidane from ENSI (Tunisia) of the PEMWN 2016 conference, the 5th IFIP international conference on Performance Evaluation and Modeling of Wired and Wireless Networks, technically co-sponsored by IFIP WG6.2 and IEEE ComSoc (see https://sites.google.com/site/pemwn2016/). This conference was held at CNAM in Paris, 22-24 November 2016. It was sponsored by Inria, CNAM and ENSI. The organization co-chairs were Samia Bouzefrane and Selma Boumerdassi. Three tutorials were given:
  - *Internet of Vehicles: From Intelligent Grid to Autonomous Cars and Vehicular Clouds* by Mario Gerla, Professor, University of California, Los Angeles.
  - *5G: Can we make it by 2020?* by Merouane Debbah, Mathematical and Algorithmic Sciences Lab, Huawei, France.
  - *Internet of Things, hyper-massive wireless networks, where are the theoretical limits?* by Philippe Jacquet, NOKIA, France.

  Sixteen papers have been selected by the technical program committee and presented during the three days of the PEMWN 2016 conference.
- ***InterIoT 2016*** The 2nd EAI International Conference on Interoperability in IoT was co-organized by Nathalie Mitton, Thomas Noël (general co-chairs) and Thomas Watteyne (TPC chair). It took place 26-27 October 2016 in Paris, France.

Tutorials

- Standards for the Industrial IoT: a Hands-on Tutorial with OpenWSN and OpenMote. Xavier Vilajosana, Pere Tuset-Peiro, Tengfei Chang, **Thomas Watteyne**. IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC), Valencia, Spain, 4-8 September 2016.
- Introduction to the IETF 6TiSCH stack with OpenWSN & OpenMote. **Thomas Watteyne**, Xavier Vilajosana, Pere Tuset-Peiro, Tengfei Chang. International Conference on Telecommunications (ICT), Thessaloniki, Greece, 16-18 May 2016.

Standardization Activities

- ***Standardization*** *meeting co-chaired by Inria-EVA*
  6TiSCH working group meeting at IETF 97, 17 November 2016, Seoul, South Korea.
- ***Standardization*** *meeting co-chaired by Inria-EVA*
  6TiSCH working group meeting at IETF 96, 18 July 2016, Berlin, Germany.
- ***Interop event*** *organized by ETSI and Inria-EVA*
  ETSI 6TiSCH 3 plugtests, 15-16 July 2016, Berlin, Germany.
- ***Standardization*** *meeting co-chaired by Inria-EVA*
  6TiSCH working group meeting at IETF 95, 4 April 2016, Buenos Aires, Argentina.
- ***Standardization*** *meeting co-chaired by Inria-EVA*
  ETSI 6TiSCH 2 plugtests, 2-4 February 2016, Paris, France.

Real-World Deployments

The networking technology developed at Inria-EVA has reached the level of maturity for it to be used in real-world deployment. We have worked on 3 main sets of deployments in 2016:

- **Save the Peaches** (http://www.savethepeaches.com/), a 23-node network in Western Argentina which monitors temperature and humidity to be predict frost events in peach orchards.
- **SnowHow** (http://www.snowhow.io/), a set of 18 low-power wireless networks (945 sensors total) deployed throughout the Californian Sierra Nevada to monitor the snowpack.
- *(current work)* A Smart Building deployment in the Inria-Paris research center.

From a networking point of view, these deployments SolSystem (see Section 6.8) as a back-end solution. Sensor data and network statistics are available at our Inria-Paris servers (https://sol.paris.inria.fr/) seconds after they were measured in the field.

Distinguished Visitors

- ***Invited Professor Mario Gerla***, from UCLA, USA. He stayed in the EVA team during 2 1-week stays (31 August-23 September, 10-20 December) to work with the EVA team on shock-wave mitigation using vehicular ad hoc networks.
- ***Invited Professor Leila Saidane***, from ENSI, Tunisia. She stayed in the EVA team from 28 November to 2 December 2016 to prepare common publications and identify further research directions.
- ***Invited Professor Diego Dujovne***, from Universidad Diego Portales, Chile. He stayed in the EVA team for a 1-week visit (22-31 July 2016) to integrate sensors in the low-power wireless platforms, to be deployed in Argantina as part of the PEACH project.
- ***Invited Professor Steven Glaser***, from UC Berkeley, USA. He stayed in the EVA team for a 1-week visit (21-25 June 2016) to explore funding opportunities beyond the REALMS associate team.
- ***Invited Professor Branko Kerkez***, from U. Michigan, USA. He stayed in the EVA team for a 1-week visit (17-22 June 2016) to work on the Internet of Water (2 papers submitted). This visit was part of the REALMS associate team.

EX-SITU Team

5. Highlights of the Year

5.1. Highlights of the Year

Michel Beaudouin-Lafon received an ERC Advanced Grant: *ONE – Unified Principles of Interaction*.

Ex-situ had a record of three research papers accepted at ACM/UIST 2016 and eleven research papers accepted at ACM/CHI 2017.

EXMO Project-Team (section vide)

FLOWERS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

The Flowers team spin-off company Pollen Robotics was created in may 2016, targeting to develop and commercialize technologies for entertainment robotics: http://pollen-robotics.com/en/

Didier Roy was award the prize Serge Hocquenguem for his work on educational robotics, http://psh.aid-creem.org/spip.php?rubrique1 et http://binaire.blog.lemonde.fr/2016/12/09/pourquoi-didier-et-eva-jouent-avec-le-meme-robot/

Sébastien Forestier, Yoan Mollard, Damien Caselli and Pierre-Yves Oudeyer obtained the notable mention demonstration award (2nd place) at the NIPS 2016 conference for their demonstration on Autonomous exploration, active learning and human guidance with open-source Poppy humanoid robot platform and Explauto library https://hal.inria.fr/hal-01404399/document

PY. Oudeyer and M. Lopes co-organized with J. Gottlieb and T. Gliga the Second Interdisciplinary Symposium on Information-Seeking, Curiosity and Attention (Neurocuriosity 2016) in London, gathering 150 researchers from neuroscience, psychology, education and machine learning/computational modelling. This was achieved in the context of the associated team Neurocuriosity. Web: https://openlab-flowers.inria.fr/t/second-interdisciplinary-symposium-on-information-seeking-curiosity-and-attention-neurocuriosity-2016/187

PY. Oudeyer and M. Lopes were awarded a 3 year-long HFSP grant with J. Gottlieb (Univ. Columbia, US) and C. Kidd (Univ. Rochester, US) for a research program targeting the understanding of active exploration in humans and monkeys through experimentation and modelling. Web: https://flowers.inria.fr/neurocuriosityproject/.

PY. Oudeyer was awarded the Lifetime Achievement Award from the Evolutionary Linguistics Association.

FLUMINANCE Project-Team (section vide)

FOCUS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Valeria Vignudelli has won the “Outstanding Master Thesis Award”, for best master thesis in logic in computer science. Awarded by the Vienna Center for Logic and Algorithms, as part of the VCLA International Student Awards (http://logic-cs.at/award/)

FUN Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- The FIT facility has become an "Infrastructure de Recherche" (Infrastructure for Research) by the CD TGIR.

5.1.1. Awards

- Aziz Mbacke and Jad Nassar won the of the Hackaton at the SenZations summer school 2016, which opened them the doors of the UpRise Festival (http://uprisefestival.co/).
- Best paper award at the PIMRC 2016 conference .
- Viktor Toldov recipient of the award "Pepite 2016": (http://www.enseignementsup-recherche.gouv.fr/cid108805/3e-edition-du-prix-pepite-tremplin-pour-l-entrepreneuriat-etudiant-53-projets-recompenses.html)

BEST PAPERS AWARDS :
[47] **27th annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC)**. V. TOLDOV, L. CLAVIER, V. LOSCRÍ, N. MITTON.

GALEN Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

- Wacha Bounliphone and Eugène Belilovsky received the Université Paris-Saclay STIC Doctoral School Best Scientific Contribution Award
- Eugène Belilovsky received the MITACS-Inria Globalink Award
- Prof. Iasonas Kokkinos was invited as keynote speaker in Astronomical Data Analysis Summer School, Chania, Greece, May 2016
- Prof. Iasonas Kokkinos was invited as keynote speaker in Local features workshop, held in conjunction with ECCV, October 2016
- Dr. Evangelia Zacharaki was appointed as guest associate editor for the Medical Physics journal
- 2nd place at the 2016 IEEE GRSS Data Fusion Contest for the paper: Simultaneous Registration, Segmentation and Change Detection from Multisensor, Multitemporal Satellite Image Pairs [30].
- Finalists (not-awarded) of the Best Papers award at the IEEE conference ICIP'16 for the paper: A Block Parallel Majorize-Minimize Memory Gradient Algorithm [16].
- Oral presentation in the Neural Information Processing Systems (NIPS), 2016 conference of the paper: Testing for Differences in Gaussian Graphical Models: Applications to Brain Connectivity [15] (oral presentations: only 1% of more than 2000 submitted papers).
- Oral presentation in the British Machine Vision Conference (BMVC), 2016, of the paper: Efficient Learning for Discriminative Segmentation with Supermodular Losses [33] (oral presentations: 7% of submitted papers).
- Oral presentation in the International Conference on Artificial Intelligence and Statistics (AISTATS), 2016, of the paper: A Convex Surrogate Operator for General Non-Modular Loss Functions [32] (oral presentations: 11% of submitted papers).

5.1.2. Other

- Acceptance of the project entitled «Predicteurs performants de l'efficacite des agents anticancereux par apprentissage profond (deep learning) de donnees radiomiques et genomiques» as part of the program *Imagerie Médicale Computationnelle*. PI: Dr. Charles Ferte, Gustave Roussy, 94805 Villejuif.

GALLIUM Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Xavier Leroy received the 2016 Royal Society Milner Award "in recognition of his exceptional achievements in computer programming which includes the design and implementation of the OCaml programming language".

Xavier Leroy received one of the two 2016 Van Wijngaarden Awards from Centrum Wiskunde & Informatica (Amsterdam).

Xavier Leroy received the ACM SIGPLAN Most Influential POPL Paper Award for his POPL 2006 paper, *Formal certification of a compiler back-end or: programming a compiler with a proof assistant* [51].

GAMMA3 Project-Team (section vide)

GANG Project-Team (section vide)

GECO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

The European Research Council (ERC) has awarded Ugo Boscain with a “Proof of concept grant" for his project *An Artificial Visual Cortex for Image Processing*.

GENSCALE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- **Colib'read Workshop, Nov 7-8 th, Institut Curie, Paris.** GenScale organized a two-day workshop to present the main results of the Colib'read ANR (2013-2016, Coordinator P. Peterlongo) to the scientific community.
- **GATB Programming days.** In 2016, GenScale organized two Genome Analysis Toolbox (GATB) trainings days in Rennes (June 15 th) and Paris (Nov. 9 th). Each event gathered 15 persons who learned how to use the GATB library to design efficient NGS tools.

GEOSTAT Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

- N. Brodu is joining GEOSTAT as a research associate (2016).
- K. Daoudi has been invited to the Senate on June 20th 2016 to accompany BatVoice which was finalist of the 2016 edition of “Tremplin Entreprises”.

4.1.1. Award

Hicham Badri is winning the AFRIF PhD price 2015 for his PhD *Sparse and Scale-Invariant Methods in Image Processing* [https://hal.inria.fr/tel-01239958].

GRACE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Events organization

- A. Couvreur, D. Augot and D. Lucas organized with L. De Feo and Hugues Randriambololona (ENST ParisTech) a spring school on coding and cryptology in la Chapelle Gauthier (Seine et Marne).
- A. Couvreur and D. Augot organized 4 days workshop in november 2016 for the ANR MANTA. The topics were: “Decoding” and “Codes from surfaces”.
- SageDays75. To conclude the ACTIS projet, we organized a one-week SageDays in August 2016. The day was spent at Inria Saclay, and people were staying at night in a cottage in Vallée de Chevreuse.

  The overall theme of this Sage Days was coding theory and exact linear algebra related to it, but there was be lots of general hacking. The aim of this Sage Days was to Introduce Sage to coding theorists; have presentations about the enhancements we made to Sage’s coding theory library during Inria’s ACTIS project; Help people to work on their own projects.

  We had a few talks on the mornings, and coding sprints on the afternoons. The first days’ talks were focused on basic functionalities of our library, the last 2 days on advanced functionalities, with an emphasis on Sage development.

  We were glad to attract several core sage developpers, who recognized the quality of the work done by D. Lucas.

GRAPHDECO Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

In addition to publications in the leading conferences and journals in computer graphics (3 ACM Transactions on Graphics [5], [6], [8], 1 IEEE Virtual Reality), we made notable contributions to related fields such as human-computer interaction (1 ACM Conference on Human Factors in Computing Systems - CHI [9]) and computer vision (3 papers presented at the International Conference on 3DVision [13], [12], [10]). Several of these results were developed in the context of the CR-Play project, which was completed in November with excellent reviews.

4.1.1. Awards

Adrien Bousseau received a Young Researcher Award from the French National Research Agency (ANR) for the project ANR DRAO.

Adrien Bousseau obtained an ERC Starting Grant funding, the project will start in February 2017.

GRAPHIK Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

- M. Bienvenu was awarded the Bronze CNRS medal 2016 http://www.cnrs.fr/ins2i/spip.php?article2197. She was an invited speaker at IJCAI 2016 (International Joint Conference in Artificial Intelligence), Early Career Spotlight track http://ijcai-16.org/index.php/welcome/view/early_career_spotlight
- Theoretical and algorithmic results on ontology-mediated query answering recognized at the best international level (10 articles in the major conferences in Artificial Intelligence and Knowledge Representation and Reasoning: IJCAI, AAAI, ECAI and KR)
- Sudoqual prototype for the evaluation of link quality in document bases considered to be used in production conditions by ABES (French Agency for Academic Libraries).
- CoGui-Capex prototype linking food descriptors to actions considered to be used in production conditions by Régilait in its milk powder factory in Macon.

4.1.1. Best papers

BEST PAPERS AWARDS :

[29] **10th International Conference on Web Reasoning and Rule Systems**. M. BIENVENU, M. THOMAZO.

HEPHAISTOS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Science

- strong advances on the analysis of cable-driven parallel robots (section 7.1.1)
- collaboration with lawyers on the ethical and legal aspects of robotics
- strong collaboration with the medical community on walking analysis, rehabilitation (section 7.2.3) and activities detection (section 7.2.1)

5.1.2. Experimentation

- extensive test period for our walkers in clinical environment (section 7.2.3)
- start of the daily activities monitoring in a retirement house (section 7.2.1)

5.1.3. Transfer

- contract with Ellcie-Healthy for the evaluation of connected objects

5.1.3.1. Awards

- J-P. Merlet has been a finalist for the best paper award of the Eucomes conference and of the IROS conference

BEST PAPERS AWARDS :
[14] **Eucomes**. J.-P. MERLET.
[10] **IEEE Int. Conf. on Intelligent Robots and Systems (IROS)**. J.-P. MERLET.

HIEPACS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Conference organization

We organized the 9th International workshop on Parallel Matrix Algorithms and Pllication (PMAA'16 - July 6-8) in collaboration with Bordeaux INP, CNRS and Université de Bordeaux. The conference that was composed of 4 invited plenary presentations and 76 regular talks. Arround 120 people attended the conference, 70 % were from Europe, 20 % from North America, 7 % from Asia; among them more than 25 % were students. We succeeded to offer free registration to the students thanks to the sponsorship we arose from Airbus DS, CEA, CERFACS, Clustervision, Labex CPU, DELL, EDF, IBM and Total that contributed to balance our budget.

More details can be found on http://pmaa16.inria.fr

HYBRID Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Two new permanent staff have joined our team this year: Ronan Gaugne (Research Engineer, Univ. Rennes 1), Ferran Argelaguet (CR2 Inria Research Scientist).
- There has been an outstanding total of six PhD Theses defended this year by members of Hybrid.
- Our team organized, together with MimeTIC team, a press conference in Paris on the "6-Finger Illusion" in May 2016, followed by a huge media coverage.

5.1.1. Awards

- Paper and demo "When the Giant meets the Ant: An Asymmetric Approach for Collaborative and Concurrent Object Manipulation in a Multi-Scale Environment" [35] obtained the Second Prize at the IEEE 3DUI Contest 2016.
- Project MANDARIN received the "Economical Impact Award 2016" from ANR (French National Research Agency).
- Project PREVIZ received a "Loading the Future' Trophy 2016" from Images et Réseaux French Competitivity Cluster.

HYCOMES Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Team members have made a significant step towards the definition of a formal semantics of multimode DAE systems, their strucutral analysis and the generation of simulation code. In particular, impulsive behavior at mode changes are handled correctly [19] (see Section 7.1 for full details). This semantics has been implemented, in part, in the SunDAE prototype software (Section 6.1).

I4S Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- In 2016, uncertainty quantification for modal analysis has been transferred to ARTeMIS software http://www.svibs.com/newsletter/newsletter_2016_09.aspx.
- In 2016, a patent has been filed by N. Berrabah and Q. Zhang, jointly with EDF and Inria [46].
- PEDAL-LORA monitoring sensor has been awarded by the European Railway Cluster Price in railway innovation.

IBIS Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

A paper based on the PhD thesis of Manon Morin was published in *Molecular Microbiology* this year [14]. Furthermore, two papers appeared in *PLoS Computational Biology*, one by Eugenio Cinquemani and colleagues from the LIFEWARE project-team and the University of Pavia [13], and one describing results from the PhD thesis of Nils Giordano, in collaboration with colleagues from the BIOCORE project-team [12]. Eugenio Cinquemani co-organized the Fifth International Conference on Hybrid Systems Biology (HSB 2016) (http://hsb2016.imag.fr/) in Grenoble.

ILDA Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

- ACM CHI 2016 Honorable mention for **TouchTokens: Guiding Touch Patterns with Passive Tokens** [4], awarded to the top 5% of all 2325 paper submissions.
- IEEE InfoVis 2016 Honorable mention for **The Attraction Effect in Information Visualization** [13].

IMAGINE Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

- We had one paper accepted to EUROGRAPHICS [10].
- Our work on virtual paper crumpling, published in ACM TOG paper in Dec. 2015 [5], was presented at ACM SIGGRAPH 2016 in Anaheim (July 2016). Moreover, our paper on the sound of virtual paper [24] received the best paper award at the ACM-EG Symposium on Computer Animation (SCA) 2016.
- We participated to two state of the art papers published in Computer Graphics Forum, respectively on Adaptive physically based models in computer graphics [13], and on 3D Skeletons [15].
- The paper The 2D Shape Structure Dataset: A User Annotated Open Access Database. Axel Carlier, Kathryn Leonard, Stefanie Hahmann, Geraldine Morin, Misha Collins. SMI'16, Computer & Graphics 58, pp. 23-30 (2016).received the "Reproducability Award" (http://www.reproducibilitystamp.com).
- Four students defended their PhD within the team.
- Anatoscope, the start-up founded by François Faure and Olivier Palombi, was selected by *Sud De France Dévelopement* to have a booth at the CES, Las Vegas, in January. They featured a live demonstration of the Living Book of Anatomy.
- The first FUI project Collodi with TeamTo and Mercenaries engineering terminated this year. We have successfully delivered the physics simulation engine for cloth and hair to include it in the commercial distribution of the project. A a second FUI project Collodi 2 focusing on animation is starting in December 2016.

4.1.1. Awards

BEST PAPERS AWARDS :
[24] **Eurographics/ ACM SIGGRAPH Symposium on Computer Animation (2016)**. C. SCHRECK, D. ROHMER, D. L. JAMES, S. HAHMANN, M.-P. CANI.

INDES Project-Team (section vide)

INFINE Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

4.1.1. Conferences and Presentations

We organized a high-profile conference in May 2016 at the Institut Henri Poincaré on "Networks: learning, information and complexity" (see: http://www.msr-inria.fr/conferences-workshops/workshop-on-networks-learning-information-and-complexity/) which gathered leading scientists in computer science, maths and statistical physics.

We organized in January 2016 a workshop at the Turing building involving top executives of LVMH and Inria researchers to exchange on innovation opportunities for LVMH notably around advertising with online social networks, data visualization, and computer vision.

We gave several invited talks at: Stochastic Networks Conference, UCSD; CIRM workshop on random matrices; Institut Henri Poincaré's "Nexus" of Information and Computation Theories; EPFL workshop for birthdays of Shannon, Urbanke and Telatar (see: http://www.etru50.com/invited-speakers/) ; LINCS scientific advisory board.

4.1.2. RIOT Summit

We successfully organized in July 2016 the first RIOT Summit in Berlin. The RIOT Summit 2016 gathered 100+ enthusiastic industrial participants, makers and academics involved in RIOT. Relevant partners such as Cisco, Samsung, Siemens, Nordic Semiconductors, as well as a number of SMEs and startups from various places in Europe gave talks on aspects of IoT communication, use cases IoT hardware, IoT open source community aspects and concepts for future IoT software and networks, as well as hands-on sessions and tutorials. See: http://summit.riot-os.org/#speakers.

4.1.3. Opening of the IoT-LAB experimental platform at the site Saclay

The project Equipex FIT deploys experimental facilities on several sites. In 2016, at the site of Saclay, the opening of the FIT IoT-LAB site followed the move from its previous location at Rocquencourt.

The platform of Saclay is an Internet-of-Things testbed and includes more than 300 nodes (175 A8-M3, 12 M3 and 120 WSN430), deployed in large experimentation rooms and space. All A8 nodes are equipped with GPS.

More information about the topology and the resources of this new site is available here: https://www.iot-lab.info/deployment/saclay/.

4.1.4. Awards

The team members have received a number of awards:

M1 intern Davi Castro de Silva received best internship prize of LIX for his work on modifying spectral methods for community detection to increase their robustness.

Best Poster Award [26] O. Hahm, C. Adjih, E. Baccelli, T. C. Schmidt, M. Waehlisch.
ICN over TSCH: Potentials for Link-Layer Adaptation in the IoT, September 2016, pp. 195-196, ACM-ICN '16 Proceedings of the 3rd ACM Conference on Information-Centric Networking , Poster. [DOI:10.1145/2984356.2985226] https://hal.inria.fr/hal-01369704

Best Demo Award [18] H. Petersen, C. Adjih, O. Hahm, E. Baccelli.
Demo: IoT Meets Robotics - First Steps, RIOT Car, and Perspectives, in: ACM International Conference on Embedded Wireless Systems and Networks (EWSN), Graz, Austria, February 2016. https://hal.inria.fr/hal-01262638

BEST PAPERS AWARDS :
[15] **5th IFIP International Conference on Performance Evaluation and Modeling in Wired and Wireless Networks (PEMWN 2016)**. F. SOMAA, C. ADJIH, I. E. KORBI, L. A. SAIDANE.

INOCS Team

5. Highlights of the Year

5.1. Highlights of the Year

- Creation of the Inria Innovation : Colinocs between Colisweb (start-up devoted to attended delivery service within the next 2 hours) and INOCS.
- Miguel Anjos joined us in September as part of the Inria International Chair program and will spend 20% of his time with us until 2020.
- A joint team between Ecole des Mines de St Etienne and INOCS involving N. Absi, D. Cattaruzza, D. Feillet, M. Ogier, F. Semet was finalist of the EURO/ROADEF Challenge 2016 devoted to an Inventory Routing Problem proposed by Air Liquid.

IPSO Project-Team (section vide)

KERDATA Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

SC16: Best Student Paper Finalist. The paper entitled *Týr: Blob Storage Meets Built-In Transactions* presented by Pierre Matri at the Supercomputing (SC16) Conference was one of the 7 papers selected for the Best Student Paper award.

This work was carried out in the context of the BigStorage project, under the supervision of Alexandru Costan, Gabriel Antoniu, María Pérez , and Jesús Montes.

There were 442 submissions, and 81 accepted papers.

ACM Graduate Student Research Competition SC16. Nathanaël Cheriere received the third prize in the SC16 ACM Student Research Competition for his work on optimizing the algorithms for the MPI collective *Scatter* and *AllGather* routines on the Dragonfly topology [1].

This work was carried out at the Argonne National Laboratory in the context of the JLESC, under the supervision of Matthieu Dorier, Rob Ross, Shadi Ibrahim, and Gabriel Antoniu.

As many as 62 posters were submitted for the Student Research Competition, out of which 14 have been selected in the Graduate category. After the presentation of their posters, 4 students have been invited to make a presentation of their work in front of a jury.

5.1.2. 9 papers in international journals

This year the team published 9 papers in high-quality journals including *ACM Transactions on Parallel Computing*, *IEEE Transactions on Parallel and Distributed Systems*, *Future Generation Computer Systems*, *Concurrency and Computation: Practice and Experience* and *IEEE Transactions on Cloud Computing*.
BEST PAPERS AWARDS :
[25] **IEEE ACM SC16 - The International Conference for High Performance Computing, Networking, Storage and Analysis 2016**. P. MATRI, A. COSTAN, G. ANTONIU, J. MONTES, M. S. PÉREZ.

LACODAM Team

5. Highlights of the Year

5.1. Highlights of the Year

- This year, we are extremely proud to have a total of 4 papers accepted at the IJCAI conference, the rank A+ conference on Artificial Intelligence.
- Another highlight of this year is that following the end of the former team, namely Dream, we could propose in 2016 a new team project, namely Lacodam, and follow smoothly all steps of the Inria project-team creation protocol. While the team is not officially created as of December 2016, our project has been positively evaluated both by Inria members and by international experts, and is thus likely to be created in early 2017.

LAGADIC Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Eric Marchand and Fabien Spindler co-authored with Prof. Hideaki Uchiyama (Kyushu Univ., Japan) a survey on pose estimation for augmented reality published in IEEE Trans. on Visualization and Computer Graphics [33].
- The second edition of the Springer Handbook of Robotics has been released this year. It contains an extended version of the chapter on visual servoing co-authored by François Chaumette, Prof. Seth Hutchinson (UIUC, Illinois) and Prof. Peter Corke (QUT, Brisbane, Australia) [77].

5.1.1. Awards

- The ANR project ENTRACTE, of which Julien Pettré is partner, has received the "ANR Grand Prix du Numérique 2016". The project is about anthropomorphic action planning and understanding: http://www.agence-nationale-recherche.fr/?Project=ANR-13-CORD-0002 (see also Section 9.2.3).
- Paper [71] has been selected has one of the five finalists for the ICARCV'2016 Best Paper Award.
- Lagadic is a member of the five finalist teams for the KUKA Innovation Award (https://www.kuka.com/en-de/press/events/kuka-innovation-award), together with the RIS group at LAAS (coordinator), the University of Siena, Italy, and the Seoul National University, South Korea. The goal is to address search and rescue operations in regions which are difficult to access or dangerous following disasters. For this, the team will explore the collaboration between a quadrotor UAV and a KUKA lightweight arm for cooperative transportation and manipulation of rigid objects (e.g., long bards), with a final peg-in-hole task to be demonstrated live at the Hannover fair during spring 2017.

LARSEN Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

- "Prix La Recherche 2016" (mention "sciences de l'information"), to Jean-Baptiste Mouret and his co-authors (Antoine Cully, Jeff Clune, Danesh Tarapore) for the article "Robots that can adapt like animals" (Nature, 2015).
- "2016 ISAL Award for Outstanding Paper of 2015 in the field of Artificial Life", awarded by the International Society for Artificial Life to Jean-Baptiste Mouret and his co-authors (Antoine Cully, Jeff Clune, Danesh Tarapore) for the article "Robots that can adapt like animals" (Nature, 2015).

LEMON Team

5. Highlights of the Year

5.1. Highlights of the Year

- Antoine ROUSSEAU spent 9 months in the office of Inria Chile (Santiago, Chile) from February to October 2016 to collaborate on the new project on *Marine Energies Research International Center* (MERIC) in Chile. Antoine is the scientific coordinator of the research line “Advanced modeling for marine energy”, and several members of LEMON, CARDAMOM and TOSCA research teams will be involved in this 8 years project in partnership with DCNS and Enel.

LFANT Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

Release of Pari 2.9 after two years of development. This stable releases includes three brand new modules (L-functions, Associative and Central Simple Algebras, and Modular Symbols), a major overhaul of the Elliptic Curves and Number Fields modules.

Iuliana Ciocanea-Teodorescu has defended her PhD thesis on *Algorithms for finite rings* in June 2016 http://www.theses.fr/2016BORD0121.

Pinar Kiliçer has defended her PhD thesis on *The class number one problem for genus-2 curves* in July 2016 [11].

LIFEWARE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Creation of the Exploratory Action *InBio* with Pasteur Institute in Paris

The InBio project has been selected in the context of a call for new research groups organized by the Center for Bioinformatics, Biostatistics and Integrative Biology (C3BI) of Institut Pasteur.

The main scientific question investigated in InBio is how one can exploit cell-to-cell differences to better learn and control the functioning of biological systems. That is, instead of seeing phenotypic variability as undesired noise that beclouds the processes of interest, we will try to harness cellular heterogeneity. In particular for control problems, because one interacts with the system, it is important to be able to predict the dynamical evolution of phenotypic heterogeneity.

A second important scientific objective of InBio is to develop more rational and systematic interactions between experimental and computational work. The virtuous loop in which experiments nurture models, that in turn, orient further experiments is universally acclaimed and installing such a loop is a central objective of many research projects. In interdisciplinary research, it is expected that this exchange of information will emerge from the interactions between the two disciplinary groups. For both practical and theoretical reasons, this is actually often not the case. In InBio, we will adopt a multidisciplinary research approach and develop an integrated environment around the design-and-test loop. This will notably involve the rational design of cell stains and of experimental plans, so that experiments are maximally-informative, and of efficient model calibration and discrimination methods. This specific focus explains the full name given to the InBio group: “Experimental and Computational Methods for Modeling Cellular Processes” (InBio simply abridges integrative biology).

InBio will be hosted at Institut Pasteur and will host experimental and theoretical research. It is a mixed structure between Inria (action exploratoire attached to Lifeware) and Institut Pasteur (research unit attached to the C3BI), and is headed by Grégory Batt.

The Dogma of the Control of the Cell Cycle by the Circadian Clock Revisited

Our long-standing and tight collaboration with Franck Delaunay’s lab in Nice culminated this year with a revisiting of the dogma of the control of the cell cycle by the circadian clock. In [9] we showed, using a coupled reaction model of the cell cycle and the circadian clock and BIOCHAM analysers [4], that a selective upregulation of Reverb-α (or an inhibition of Bmal1) during mitosis is necessary to explain the period and phase data observed in NIH3T3 fibroblasts in different serum concentrations. This mechanism constitutes a reverse control of the circadian clock by the cell divisions which was previously outlooked but is overriding in some spontaneously dividing cell types such as non-confluent NIH3T3 fibroblasts.

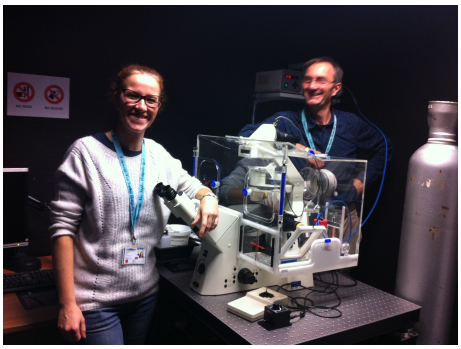


Figure 1.
Céline Feillet and Franck Delaunay, CNRS Nice,
with the large-scale time-lapse video microscope which produced the unicellular 72h data studied in [9].

LINKMEDIA Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

LINKMEDIA ranked first at the TRECVid 2016 Hyperlinking international benchmark [12].

LINKMEDIA is selected as the organizer of the IEEE Workshop on Information Forensics and Security in 2017.

LINKMEDIA deeply involved in the winning bid for the organization of the ACM Conf. on Multimedia in 2019.

LINKS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Certain Query Answering as Access Control

P. Bourhis [24] presented at **LICS** — the top conference in logic in computer science — a general framework for querying databases with visible and invisible relations. This work was done in cooperation with Oxford, Santa Cruez, and Bordeaux. It generalizes in a uniform manner the problems of certain query answering and access control for relational databases. Invisible relations are subject to the open world assumption possibly under constraints, while visible relations are subject to the closed world assumption. Bourhis then shows that the problem of answering Boolean conjunctive queries in this framework is decidable, and studies the complexity of various versions of this problem. It turns out that the complexity increases compared to the problem of certain query answering, given that the closed world assumption is adopted for the added visible relations.

Five ANR Projects

Two new ANR projects were accepted this year: *Delta* and *Headwork*. This makes Links a partner of 5 ANR projects in 2016.

PhD Defense of A. Boiret

The defense of the PhD thesis of A. Boiret [11] on "Normalization and Learning of Transducers on Trees and Words" under the supervision of J. Niehren and A. Lemay was highly appreciated by the reviewers. In particular, he illustrated very clearly how to learn top-down tree transformations subject to regular schema restriction [31], [33], [34]. Furthermore, he solve a problem open for more than 20 years on how to learn rational functions, i.e. word transducers with regular lookahead.

M3DISIM Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Official launch of M3DISIM as an Inria project-team (joint with Ecole Polytechnique / LMS) on June 1st
- Habilitation (HDR) of Philippe Moireau on November 28th

MADYNES Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

4.1.1. Masdin associate team

Thanks to previously existing collaborations, a new associate team with SnT at University of Luxembourg has been created in 2016 with a focus on softwarization of networks.

MAESTRO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

The paper “Access-time Aware cache Algorithms” by Giovanni Neglia; Damiano Carra; Mingdong Feng; Vaishnav Janardhan; Pietro Michiardi and Dimitra Tsigkari got the Best Paper Award at ITC 28 in Würzburg.

The article “Sonorous Cartography for Sighted and Blind People” by Didier Josselin, Andelbery Saidi, Dorian Roussel, Said Boularouk, Olivier Bonin, Eitan Altman, Driss Matrouf got the Best Short Paper Award at the conference 19th AGILE International on Geographic Information Science, Helsinki, Finland, June 14-17, 2016.

S. Alouf has received a “Recognition of Service Award” from the ACM in September 2016.

BEST PAPERS AWARDS :

[46] **International Teletraffic Congress ITC-28**. G. NEGLIA, D. CARRA, M. FENG, V. JANARDHAN, P. MICHIARDI, D. TSIGKARI.

[40] **AGILE’2016 - 19th AGILE International Conference on Geographic Information Science**. D. JOSSELIN, D. ROUSSEL, S. BOULAROUK, A. SAIDI, D. MATROUF, O. BONIN, E. ALTMAN.

MAGIQUE-3D Project-Team (section vide)

MAGNET Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- We have been successful in many calls: ERC PoC project SOM (JAN RAMON leader), ANR project GRASP (PASCAL DENIS leader), ANR project PAMELA (MARC TOMMASI is the scientific coordinator), ANR project REM (PASCAL DENIS local leader), ADEME project MUST (JAN RAMON leader), Inria Associate Team LEGO (AURÉLIEN BELLET local leader).
- Scientific advances have been recognized by the community, in top ranked conferences and journals such as ICML, NIPS, JMLR, EMNLP, EACL and IJCAI.

5.1.1. Awards

- CHLOÉ BRAUD, who was supervised by PASCAL DENIS from 2012 to 2015, received the 2016 PhD Award from ATALA, the French NLP association.
- PAUL VANAESEBROUCK, who was supervised par AURÉLIEN BELLET and MARC TOMMASI, has reveived the "Grand Prix du stage de Recherche" from École Polytechnique Paris for his internship in MAGNET (see Section 7.1).

MAGRIT Project-Team (section vide)

MAMBA Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Personnel

Marie Doumic has moved in September 2015 for a 1-year sabbatical to the Wolfgang Pauli Institute in Vienna. Stefan Hoehme left in July 2015 to start a prestigious "Emmy Noether" junior research group at University of Leipzig, faculty for computer sciences. Of note, this is the first Emmy Noether research group in Leipzig, and he was the only one accepted this year (out of 20 presented).

Nicolas Vauchelet left the team in September 2015, becoming a full professor at University Paris XIII.

5.1.2. THE ITMO Cancer national call.

The team has been successful in simultaneously participating in 2 different funded projects of the ITMO Cancer THE ("Tumour Heterogeneity in its Ecosystem", a programme managed by INSERM) national call for 2016: one, EcoAML (4 teams), on early leukaemogenesis in Acute Myelogenous Leukaemia (AML), headed by François Delhommeau (CDR St Antoine, Paris), with whom we have a long-lasting collaboration, and the other, MoGlImaging (8 teams), on treatment-induced treatment resistance and heterogeneity in glioblastoma, headed by Elizabeth Moyal (INSERM, Toulouse), a project inside which we have recently developed a work collaboration with the team of François Vallette (INSERM, Nantes) on the in-vitro resistance of glioblastoma to temozolomide. In both these collaborative projects, begun in November 2016 and to be integrated in 2017 in the future THE consortium (gathering the 6 projects laureates to the national call), we propose to develop our phenotype-structured models for both the cancer and the supporting stromal cell populations, with representation of mutualistic interactions between them.

MANAO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

In term of publication, we are regulary publishing our work at the prestigious conference SIGGRAPH. This year was particularly successfull with two plain papers [17], [16] and one talk [19]. But this year more especially, an image from our work [16] were selected as the front cover of the corresponding special issue of ACM Transactions on Graphics.

Another great success is the creation, leaded by members of the LP2N, of a first workshop on nano-appearance. The goal of this workshop was to bring together people from the industry and the academia, and from domains that seem very different considering the scale they are interested in but close by the object of their studies: the appearance of materials. A rare initiative, this workshop took place during two days in November 2016.

MARELLE Project-Team (section vide)

MATHERIALS Project-Team (section vide)

MATHNEURO Team (section vide)

MATHRISK Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Creation of a joint seminar on Numerical probability and Mathematical Finance with the LPMA laboratory, University Paris-Diderot.
- Organization by B. Jourdain with B. Bouchard (Université Paris-Dauphine) and E. Gobet (Ecole Polytechnique) of the 2015-2016 thematic semester on Monte Carlo methods (financed by the Institute Louis Bachelier) at Institut Henri Poincaré, Paris https://www.ceremade.dauphine.fr/montecarlo/MonteCarlo.html, and the international closing conference in July 2016. https://montecarlo16.sciencesconf.org

MAVERICK Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Presentations at Siggraph

The paper “Flow-Guided Warping for Image-Based Shape Manipulation” co-authored by Romain Vergnes and Georges-Pierre Bonneau was presented at Siggraph 2016 [3]. The paper is completed by an open-source software running on mobile phones that allow interactive manipulation of images (http://bonneau.meylan.free.fr/ShwarpIt/ShwarpIt.html). See sections 6.7 and 7.1.3 .

MCTAO Project-Team (section vide)

MEMPHIS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Numerical simulation of zebrafish larvae C-bend

This part is performed in collaboration with the MRGM laboratory (Laboratoire Maladies Rares : Génétique et Métabolism, https://mrgm.u-bordeaux.fr/). They are interested in the swimming of a zebrafish larvae under genetic modifications. One aim is to quantify the power spent by such fishes to swim after a stimuli reaction. The numerical simulation we develop can help computing integral quantities such the power [39]. This simulation is challenging due to coupling several methods like image treatment (from movies given by MRGM), optimal transport [58] and numerical simulations.

First 2D numerical results have been performed from a series of 615 pictures obtained at a rate equal to 15 000 images per second. The fish is a 8-day zebrafish larvae (length is $\ell = 7\,mm$) presented in figure 5 .

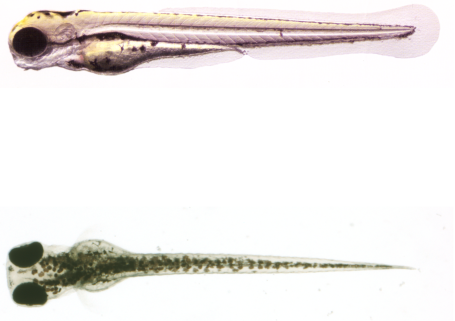


Figure 5. Pictures of a 8-day zebrafish larvae. Source: MRGM.

All the 615 pictures have been post-processed to remove the displacement of the center of mass (due to the hydrodynamic forces) as well as the rotation angle (due to the hydrodynamic torques) to isolate the kinematic of the deformation. Indeed, the displacement of the mass center and the rotation angle have to be computed as being the results of the flow effects generated by the fish deformation. The numerical solver requires however more than 615 images for the overall simulation due to small times steps limitation. The missing images are thus computed using optimal transportation with the algorithm presented in [40]. This method gives also the deformation velocity inside the body that is necessary for our numerical simulation based on the penalty method (see figure 4 for an example of deformation velocity computation).

A comparison between experimental and numerical swimming behaviors is presented in figure 6 . The qualitative behaviors look quite similar. In a more quantitative way, figures 7 and 8 show the temporal evolution of the rotating angle as well as the position of the center of mass. The numerical results (displacement of the mass center and the rotation) are quite close to the experimental ones (the ones removed in the post-processed of the original pictures).

The small differences can be explained by the fact the the actual simulation is only two-dimensional. Another explanation is that the deformation velocity obtained by optimal transportation is by definition irrotational and *a priori* non divergence free. We are now working on the 3D simulation as well as a modified (sub-)optimal transportation including rotational effects for a divergence free field.

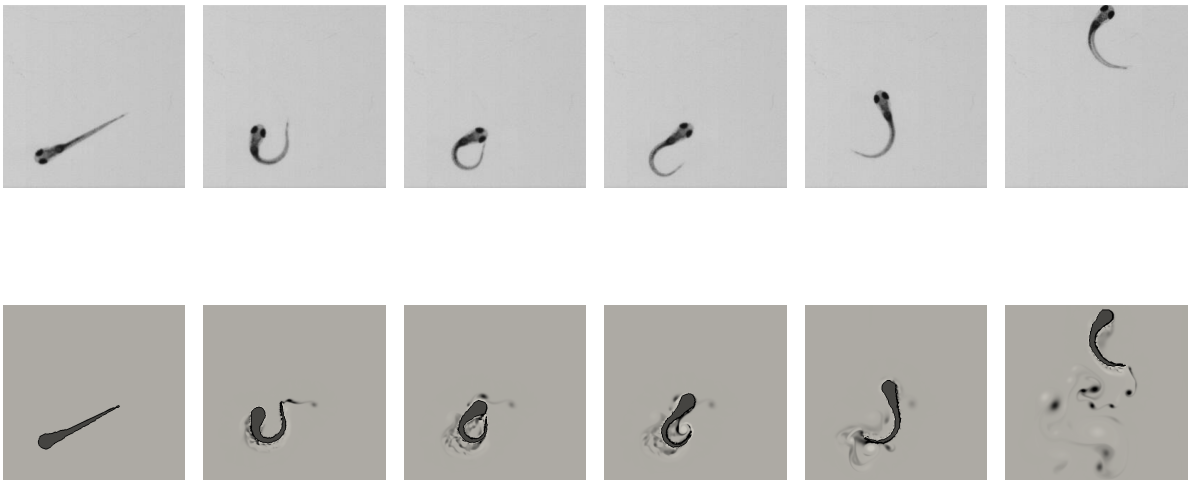


Figure 6. Comparison between experimental (top) and numerical results (bottom) at t_0, $t_0 + 0.7$ ms, $t_0 + 1.1$ ms, $t_0 + 1.3$ ms, $t_0 + 2$ ms and $t_0 + 4.1$ ms from left to right. Experiments results given by MRGM.

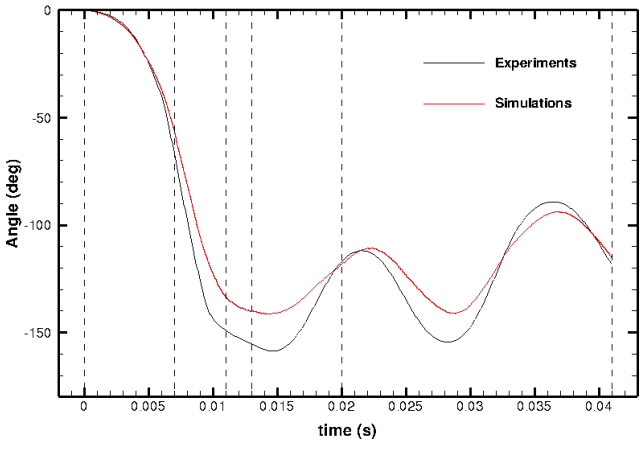
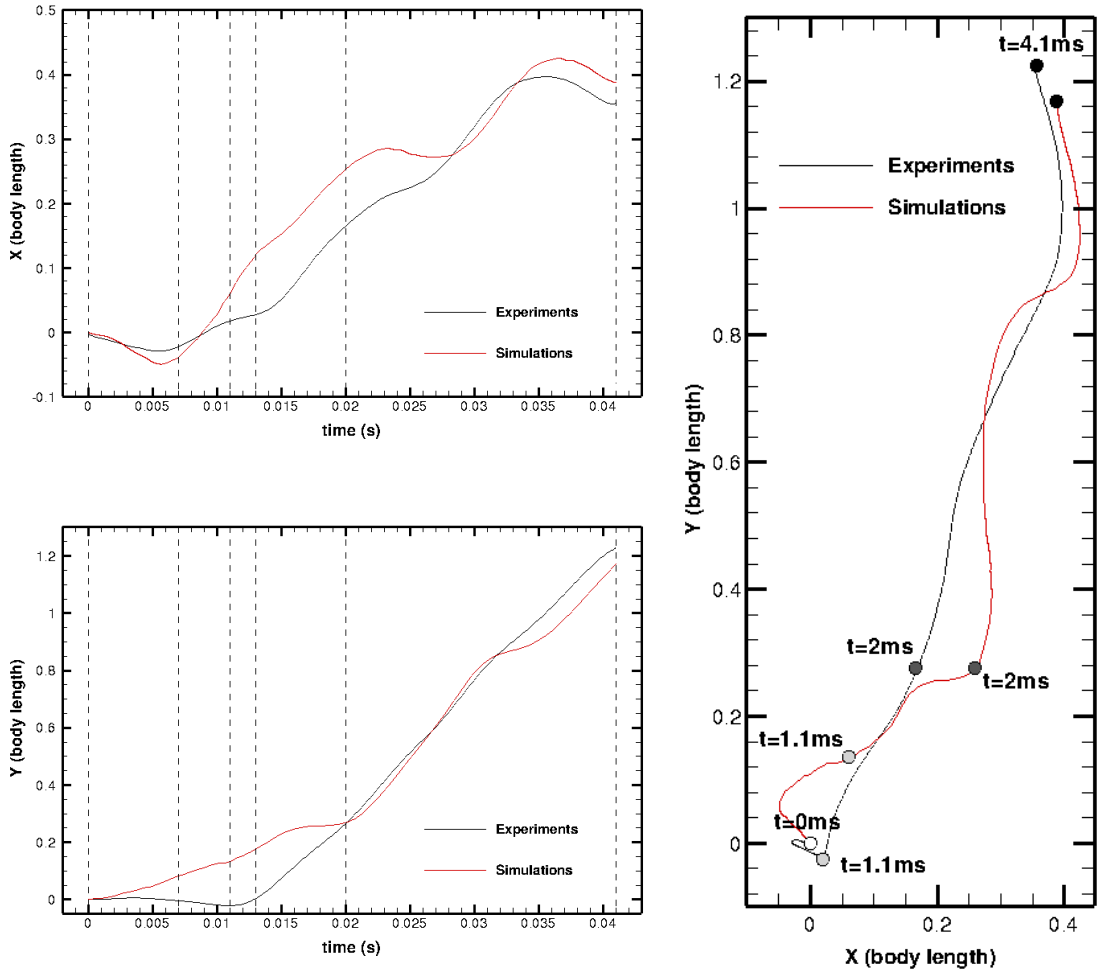


Figure 7. Temporal evolution of the rotation angle.



(a) Temporal evolution of the center of mass. (b) Position of the center of mass.

Figure 8. Kinematic results for the zebrafish swimming.

MEPHYSTO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

The team obtained two striking results in 2016:

- In collaboration with O. Blondel, T. Franco, and P. Gonçalves, M. Simon has made significant progress towards the *weak KPZ universality conjecture*, which states that a large class of one-dimensional weakly asymmetric conservative systems should converge to the KPZ equation, cf. [28], [7].
- In collaboration with F. Otto, M. Duerinckx and A. Gloria developed a complete theory of fluctuations in stochastic homogenization, cf. [39].

MEXICO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Diagnosis, Anti-alignments and Coverability

DIAGNOSIS

Several new advances were obtained, concerning Diagnosis in Infinite-State Probabilistic Systems, Approximate Diagnosability of Stochastic Systems, and Diagnosability of Repairable Faults; see the 'New Results' section for a detailed description.

ANTI-ALIGNMENTS IN CONFORMANCE CHECKING – THE DARK SIDE OF PROCESS MODELS

Conformance checking techniques asses the suitability of a process model in representing an underlying process, observed through a collection of real executions. These techniques suffer from the well-known state space explosion problem, hence handling process models exhibiting large or even infinite state spaces remains a challenge. One important metric in conformance checking is to asses the precision of the model with respect to the observed executions, i.e., characterize the ability of the model to produce behavior unrelated to the one observed. By avoiding the computation of the full state space of a model, current techniques only provide estimations of the precision metric, which in some situations tend to be very optimistic, thus hiding real problems a process model may have. In [15], [25] we present the notion of anti-alignment as a concept to help unveiling traces in the model that may deviate significantly from the observed behavior. Using anti-alignments, current estimations can be improved, e.g., in precision checking. We show how to express the problem of finding anti-alignments as the satisfiability of a Boolean formula, and provide a tool which can deal with large models efficiently. In [19], [20], a novel approach to measure precision and generalization is presented, which relies on the notion of anti-alignments. We propose metrics for precision and generalization that resemble the leave-one-out cross-validation techniques, where individual traces of the log are removed and the computed anti-alignment assess the model's capability to describe precisely or generalize the observed behavior.

APPROACHING THE COVERABILITY PROBLEM CONTINUOUSLY

The coverability problem for Petri nets plays a central role in the verification of concurrent shared-memory programs. However, its high EXPSPACE-complete complexity poses a challenge when encountered in real-world instances. In [13], we develop a new approach to this problem which is primarily based on applying forward coverability in continuous Petri nets as a pruning criterion inside a backward coverability framework. A cornerstone of our approach is the efficient encoding of a recently developed polynomial-time algorithm for reachability in continuous Petri nets into SMT. We demonstrate the effectiveness of our approach on standard benchmarks from the literature, which shows that our approach decides significantly more instances than any existing tool and is in addition often much faster, in particular on large instances.

MIMESIS Team (section vide)

MIMETIC Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

This year, we feature four of the team's research results as specific highlights, in particular due to their high publication impacts.

Our work entitled "Validation of an ergonomic assessment method using Kinect data in real workplace conditions" ([15] by Pierre Plantard, Hubert PH Shum, Anne-Sophie Le Pierres and Franck Multon) has been accepted in the journal Applied Ergonomics. This publication is very important for future works in ergonomics as it demonstrates the relevance of the Kinect data correction for in-site (on a real workstation in factories) in an ergonomic purpose.

A State of the art paper, "Muscle-Based Control For Character Animation" has been published in Computer Graphics Forum ([6] by Ana Lucia Cruz Ruiz, Charles Pontonnier, Nicolas Pronost and Georges Dumont). It presents an organized review of over a decade of research in muscle-based control for character animation, its fundamental concepts and future directions for development. The core of this review contains a classification of control methods, tables summarizing their key aspects, and popular neuromuscular functions used within these controllers.

Our work entitled "Perceptual Effect of Shoulder Motions on Crowd Animations" ([11] by Ludovic Hoyet, Anne-Hélène Olivier, Richard Kulpa and Julien Pettré) has been accepted and presented in SIGGRAPH 2016, the premier and most selective computer graphics scientific event, and published in ACM Transaction on Graphics. It explores how local interactions between walkers are perceived by users when secondary shoulder motions are displayed, and demonstrates the benefits of such secondary animations in large-scale crowd scenarios.

Two papers exploring the effects of the avatar's representation on users' sense of "virtual embodiment" (i.e., the extent to which we accept an avatar to be our representation in the virtual environment) were published in Frontiers in Robotics and AI [10] and in IEEE VR [19], resulting from a collaboration between Ludovic Hoyet (MimeTIC), and Ferran Argelaguet and Anatole Lécuyer (Hybrid). This work paves the way to further collaborations on understanding how we accept virtual characters as our own representation in virtual environments.

5.1.1. Awards

This year, the ANR Entracte leaded by CNRS/LAAS received the best price for ANR Project in November 2016 in Paris ("Grand prix du Numérique des 10ans de l'ANR", link).

The ANR Jeune Chercheur project Cinecitta, led by Marc Christie, has also been awarded one of the 10 "iconic" projects (*projets emblématiques*) for the 10 years of the ANR, and will be presented at the 10 years celebration of the ANR in December 2016.

MIMOVE Team

5. Highlights of the Year

5.1. Highlights of the Year

Members of MiMove are co-founders of the Ambiciti start-up (http://ambiciti.io) together with the Inria team CLIME, and the NUMTECH and the Civic Engine SMEs. Ambiciti's technology is a single platform delivering real-time data on street-by-street exposure and risks on multiple environmental pollutants. The platform's technology leverages open data along with cloud, IoT, mobile and data analytics technologies. Ambiciti collects real-time, street-by-street pollution data and provides urban citizens with a means to personalize their decisions with regard to environmental hazards. The aim is to enable citizens to make more informed choices about their activities, personal behavior and location, and to protect their own health. Ambiciti also supplies businesses with crucial data that allows to better inform consumers and to increase the valuation of services (e.g., real estate). Eventually, Ambiciti supports governments in protecting citizens' health and in growing cities more sustainably in providing the necessary urban pollution data. Key elements of the Ambiciti platform include the Ambiciti mobile app that leverages mobile phone sensing middleware solutions to monitor the individual and collective exposure of citizens to environmental pollutions in a resource-efficient way (more at https://www.inria.fr/en/centre/paris/news/ambiciti-an-application-a-start-up). The first version of the Ambiciti App (successor of SoundCity) deals with noise and air pollution. In particular, Inria and the Paris city council were awarded a *Décibel d'Argent* prize for the App (more at https://www.inria.fr/en/centre/paris/news/2016-decibel-d-or-golden-decibel-competition-ambiciti-receives-the-decibel-d-argent-silver-decibel-prize-in-the-research-category).

MINT Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

4.1.1. Evita

EVITA is a tactile feedback tablet, produced by Hap2U SME company, based in grenoble. It is presented at CES in january 2017, the SME has been awarded a CES innovation award. This device is issued from a strong collaboration with MINT group. Eric Vezzoli PhD thesis, contributed significantly to this device. EVITA is a very generic interaction device, and several projects are currently being discussed for understanding the fields of applications of this device. It is also, in particular, the hardware support for our haptic book for children, described below, that is our second highlight for this raweb.

4.1.2. Haptic book

The first digital book augmented with a high fidelity feedback has been released in October 2016. Based on a scenario and illustrations made by Dominique Maes - an artist from Belgium - this haptic book was presented for the first time during "la nuit des bibliothèques" in Lille. The popularity of this project as well as its possible social outcomes were underlined in a paper in a national magazine ("Science et Avenir", November 2016)

4.1.3. Forum Oeuvres et Recherches

MINT played an active role in the "Oeuvres et recherches" project (http://www.cristal.univ-lille.fr/oeuvres-et-recherches/), a platform that aims at higlighting and supporting collaborations between researchers and artists in the Hauts-de-France and in Belgium. Since 2010, these collaborations have resulted in significant contributions for these two communities at the regional and national levels. Organised at the Université de Lille on December 2nd 2016, the F O O R event was an opportunity to review more than five years of art-science projects in the region and Belgium, highlighted more than 40 art-science projects, and more importantly to prepare the future and discuss strategies for supporting such projects.

4.1.4. ControllAR

The ControllAR project, started in 2016, investigates the appropriation of visual feedback on control surfaces for multimedia production systems. It has already yielded many results. The system and results of a study on electronic musicians were presented both as a paper and as a demo at the ACM Internation conference on Surfaces and Spaces (ISS 16) where it received a best demo award. The software was released and is available at http://forge.lifl.fr/ControllAR. ControllAR was also presented during multiple events, both for the general public and for electronic musicians. The project continues with the design of a portable hardware solution and a long term study of the effects of the system on musicians' playing techniques.

4.1.5. Awards

- Best demo award for *ControllAR : appropriation of visual feedback on control surfaces* [16] @ ACM International Conference on Interactive Surfaces and Spaces (ISS 16).
- Best work in progress at Eurohaptics 2016 for the work The human perception of transient frictional modulation, David Gueorguiev, Eric Vezzoli, André Mouraux, Betty Semail, Jean-Louis Thonnard
- SME Hap2U had a "CES innovation award", based on the collaboration that MINT group has with them (E-vita tactile feedback tablet) at CES (january 2017).

MISTIS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- The Pixyl startup (http://pixyl.io) created in March 2015 by F. Forbes (Mistis) with M. Dojat (INSERM), a former Mistis post-doctoral fellow S. Doyle (CEO) and IT Translation is one of the two Inria start-ups winners of the NETVA 2016 competition. S. Doyle travelled to Washington to take part in a personalized support program to learn about the North American markets. The NETVA competition is open to French hi-tech start-ups. It is organized by the science and technology departments of the French embassies in Canada and the USA. Pixyl develops neuro-imaging software which automatically analyses brain lesion load using MRI scans, for improved decision-making during clinical trials and routine clinical use.
- Vision 4.0 FUI Minalogic project: Mistis is one of the 4 partners in the Vision 4.0 project that started in October 2016. This is one of the 8 projects funded by the Minalogic Pôle de competitivité in 2016. The support is of 3.4 Meuros.

5.1.1. Awards

- 2016 Award for Outstanding Contributions in Neural Systems. Antoine Deleforge (now with the PANAMA team, Inria Bretagne-Atlantique), Florence Forbes (MISTIS team) and Radu Horaud (PERCEPTION team) received the 2016 Hojjat Adeli Award for Outstanding Contributions in Neural Systems for their paper: A. Deleforge, F. Forbes, and R. Horaud (2015), Acoustic Space Learning for Sound-source Separation and Localization on Binaural Manifolds, International Journal of Neural Systems, 25:1,(21 pages) [75]. The Award for Outstanding Contributions in Neural Systems established by World Scientific Publishing Co. in 2010, is awarded annually to the most innovative paper published in the previous volume/year of the International Journal of Neural Systems.
- MITACS Globalink Research Award - Inria - for research in Canada. Alexis Arnaud received the MITACS award and a 5 kdollars grant to spend 5 months in the Mathematics and statistics department of McGill University in Montreal, Canada, working with Prof. Russel Steele.

Mjolnir Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Personnel

Mathieu Nancel joined us as an Inria researcher in November.

Marcelo Wanderley joined us in February as part of the Inria International Chair program and will spend 20% of his time with us until 2020.

Ed Lank, Associate Professor at the University of Waterloo, joined us in September for a long-term visit (10+ months) funded by Région Hauts-de-France and Université Lille 1.

In partnership with Campus France and Inria, Mitacs' Globalink Research Award program sponsored the visits of three canadian students in our group: Nicholas Fellion (Carleton University), Hrim Mehta (Ontario Institute of Technology) and Aakar Gupta (University of Toronto).

5.1.2. Publications & dissemination

Mjolnir presented seven papers and one "late-breaking work" at the ACM CHI 2016 conference in May, the most prestigious conference in our field.

The *Animated transitions* web site launched in March illustrates previous works by Fanny Chevalier and others on this topic (Histomages, Diffamation and Gliimpse).

5.1.3. Awards

"Honorable mention" (top 5% of the 2300+ submissions) from the ACM CHI 2016 conference to the following three papers:

- "Egocentric analysis of dynamic networks with EgoLines", from J. Zhao, M. Glueck, F. Chevalier, Y. Wu & A. Khan
- "Modeling and understanding human routine behavior", from N. Banovic, T. Buzali, F. Chevalier, J. Mankoff & A. Dey
- "Direct manipulation in tactile displays", from A. Gupta, T. Pietrzak, N. Roussel & R. Balakrishnan

"Springer award for best doctoral contribution" to Amira Chalbi-Neffati at the IHM 2016 conference.
BEST PAPERS AWARDS :
[40] **CHI '16 - Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems**. J. ZHAO, M. GLUECK, F. CHEVALIER, Y. WU, A. KHAN.
[23] **ACM CHI Conference on Human Factors in Computing Systems 2016**. N. BANOVIC, T. BUZALI, F. CHEVALIER, J. MANKOFF, A. K. DEY.
[29] **CHI 2016 - Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems**. A. GUPTA, T. PIETRZAK, N. ROUSSEL, R. BALAKRISHNAN.

MNEMOSYNE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. First PhDs defended

2016 is a very special year for our young team Mnemosyne, since our first three PhDs have been defended in October and November [1], [2], [3].

MODAL Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

The major highlight of Modal is related to transfer of its research towards the private sector. In 2016, several major bilateral contracts have been signed between Modal and leading international companies based in Hauts-de-France. Those collaborations directly proceed from the fundamental research carried within the team (see Section "Bilateral Contracts and Grants with Industry").

MOKAPLAN Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

New ERC Grant for G. Peyré

Gabriel Peyré is the recipient of a second ERC grand (consolidator), project NORIA (http://www.gpeyre.com/noria/) on Numerical Optimal tRansport for ImAging, that will start on Oct. 2017.

Pisa

Four members of Mokaplan : G. Peyré, G. Carlier, J-D. Benamou, Simone di Marino (starting 2017) have been invited speakers at the Pisa Scuola Normale Bi-Annual Optimal Transport Conference (November 7-11). This is considered as the most prestigious conference in the field.

MONC Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Last year saw a net increase in the diffusion of our work outside our own academic circle. Perrine Berment has clinched a seat in the national final of *Ma thèse en 180 secondes* after winning regional competition. Research achieved in the team was mentioned in popular radio shows like https://www.franceinter.fr/emissions/futur-proche/futur-proche-28-octobre-2016?xtmc=kurde_medecin&xtnp=1&xtcr=14. This opens new collaboration opportunities locally and nationaly for the team.

On a scientific point of view, the team has significantly increased its work on modeling tumor heterogeneity and texture analysis with very promising results so far, particularly in the thesis of Thibaut Kritter, Agathe Peretti, Cynthia Perier. We have developed a model for texture evolution over time which may offer a much better insight than approaches using statistical methods on texture features (*e.g.* radiomics).

5.1.1. Awards

Julien Jouganous has won *Prix Le Monde de la Recherche Universitaire*, http://www.lemonde.fr/sciences/article/2016/11/23/prix-le-monde-de-la-recherche-2016-l-evolution-du-cancer-en-equations_5036804_1650684.html.

MORPHEME Project-Team (section vide)

MORPHEO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

The work on estimating the visual contrast on a 3D mesh has been awarded the best paper award at the Pacific Graphics 2016 conference.
BEST PAPERS AWARDS :
[] **Computer Graphics Forum**. G. NADER, K. WANG, F. HÉTROY-WHEELER, F. DUPONT.

MULTISPEECH Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

We ranked 1st ex aqueo for the ”Professionally produced music recordings” task of the 2016 Signal Separation Evaluation Campaign (SiSEC) [39].

MUSE Team (section vide)

MUTANT Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

Startup Creation

Arshia Cont with José Echeveste and Philippe Cuvillier (former PhD students) are creating a Startup around Antescofo to bring the product to greater public starting March 2016 http://antescofo.com. The project is hosted by the French Incubator AgoraNov.

It was awarded the “Emergence Award” in 2015 that help emerging new technology companies to study the project, and an i-LAB prize in 2016, supported by the French Ministry of Culture and Bpifrance, and it has been a finalist of the Midemlab 2016.

MYCENAE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- PhD defense of Lucile Megret. Explosion of limit cycles : qualitative analysis, numerical simulations and models. Université Pierre & Marie Curie – Sorbonne Universités, November 25th 2016.
- PhD defense of Elif Köksal Ersöz. A mathematical study on coupled multiple timescale systems, synchronization of populations of endocrine neurons. Université Pierre & Marie Curie – Sorbonne Universités, December 13th 2016.
- PhD defense of Tanguy Cabana. Limits of randomly connected networks and their dynamics. Université Pierre & Marie Curie – Sorbonne Universités, December 14th 2016.
- Invited plenary conference at ICAR2016 http://www.icar2016.org 18th International Congress on Animal Reproduction. Multiscale mathematical modeling of the hypothalamo-pituitary-gonadal axis. Tours (France), June 26-30th 2016.

MYRIADS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- The PaaSage European project was successfully completed in November 2016 with an excellent rating from the reviewers. The PaaSage project developed a model-based, cross-cloud development and deployment platform that overcomes platform heterogeneity while enabling dynamic, fully-automated application scaling and cloud bursting. The main Myriads contribution is the Adapter subsystem, responsible for supporting dynamic, cross-cloud application adaptation.

5.1.1. Awards

- Baptiste Goupille-Lescar won the prize of the organizing committee of MMS Challenge 2016 (INSA Science Day).
- Anna Giannakou won the "Most Promising Experiment" award at the Grid'5000 winter school in February 2016 for her work "Towards Self Adaptable Security Monitoring in IaaS Clouds".

NACHOS Project-Team (section vide)

NANO-D Project-Team (section vide)

NECS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- C. Canudas de Wit has been elevated to the grade of Fellow of the IEEE.
- C. Canudas de Wit has been named a Fellow of the IFAC (International Federation of Automatic Control).
- C. Canudas de Wit has received an ERC Advanced Grant for the project “Scale-FreeBack”.
- The GTL platform and website went public in November.
- G. De Nunzio received the “Prix de thèse 2016 de la COMUE Université Grenoble Alpes” for his doctoral work, co-advised by C. Canudas de Wit and P. Moulin.
- A. Kibangou defended his HDR (Habilitation à diriger les recherches).
- P. Frasca and M.L. Delle Monache have joined the team as permanent researchers.
- H. Fourati has edited the book “Recent Advances on Multisensor Attitude and Heading Estimation: Fundamental Concepts and Applications”, by Taylor & Francis Group LLC.

NEUROSYS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Laurent Bougrain has co-supervised and co-written a two-volume book for anyone who uses Brain-Computer Interfaces, in English [17], [18] and for the first time in French [19], [20]. The multidisciplinary work has involved around fifty authors from various backgrounds, who write about their particular area of expertise in a way that makes it accessible to a wider audience. That includes healthcare professionals, video game developers, researchers and students, as well as a much wider audience, curious to explore the philosophical and ethical aspects of this subject. The book also has a practical side, with tutorials illustrating the use of BCI and the OpenViBE software platform (see 6.6 and http://openvibe.inria.fr). Laurent Bougrain contributed to several chapters about the state of the art, medical applications and OpenViBE [15], [10], [12], [13] (French version: [16], [9], [11], [14]).
- We stepped up our collaboration with the *department of neurology of the university hospital in Nancy* (Louise Tyvaert, Louis Maillard, Laurent Koessler) leading to i) a **project PEPS JCJC** on modeling and simulation of the oscillatory activity of the memory system during sleep and under general anesthesia (see section 9.2) a **PhD thesis** started in October 2016 (Amélie Aussel), funded by UL and co-supervised by Laure Buhry (Loria-Neurosys) and Radu Ranta (CRAN). This thesis will make use of SEEG recordings made in epileptic patients and will use preliminary results on hippocampal modelling obtained thanks to the project PEPS JCJC.

NON-A Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

UCoCoS

The H2020 project UCoCoS (Understanding and Controlling of Complex Systems, supervisors: W. Michiels, J.-P. Richard, H. Nijmeijer, 2016-2020) has started effectively this year: kick-off meeting in Eindhoven in March and, at the end of this year, recruitment of the 6 PhD students (including 4 jointly with Lille: H. Silm, J. Thomas, D. Dileep, Q. Voortman) in the 3 hosting institutions.

5.1.1. Awards

D. Efimov is Outstanding IEEE TAC reviewer.

NUMED Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

In the context of a long standing collaboration with Sanofi group, E. Grenier develops a software for the study of the stability of vaccines. This software has been used in a formal presentation of a new vaccine to the FDA (Food and Drug Administration).

4.1.1. Awards

Vincent Calvez has been award the prize of the European Mathematical Society (2016).

ORPAILLEUR Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- The conference paper got the best paper award at the International Conference on Concept Lattices and Applications 2016 in Moscow, July 2016 (https://cla2016.hse.ru/awards). This reward was given to the paper and also to the whole work on the formalization of functional dependencies done by the four authors during the last years.
- In July 2016, Chedy Raïssi visited NASA Ames and SETI Institute as part of the Frontier Development Lab. He worked there for six weeks on the planetary defense community and focused on Delay-Doppler radar imaging. This stay was organized in the framework of the NASA "Asteroid Grand Challenge" program, where participation is based on a strong selection process.

BEST PAPERS AWARDS :
[33] **Thirteenth International Conference on Concept Lattices and Their Applications (CLA 2016)**. V. CODOCEDO, J. BAIXERIES, M. KAYTOUE, A. NAPOLI.

PACAP Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

André Seznec was elevated as an ACM Fellow in December 2016 with the citation: “For contributions to branch prediction and cache memory design”.

André Seznec won the three tracks of the 5th Championship on Branch Prediction.

5.1.1. Awards

Sajith Kalathingal, Sylvain Collange, Bharath Swamy and André Seznec received the Best Paper award of the SBAC-PAD 2016 conference.

Damien Hardy, Isabelle Puaut, Yiannakis Sazeides won the best paper award of the Embedded Systems Software track at DATE 2016: Probabilistic WCET estimation in presence of hardware for mitigating the impact of permanent faults. Design, Automation and Test in Europe. Dresden, Germany, March 2016.

Aswinkumar Sridharan and André Seznec won the best paper award for “Discrete Cache Insertion Policies for Shared Last Level Cache Management on Large Multicores” at the 30th IEEE International Parallel & Distributed Processing Symposium, May 2016, Chicago.

For his PhD thesis [10] “Increasing the Performance of Superscalar Processors through Value Prediction”, Arthur Perais received:

- Prix de thèse Fondation Rennes 1, 1er Prix de l’école doctorale MATISSE;
- Prix de thèse Gilles Kahn, accessit.

BEST PAPERS AWARDS :
[46] **5th JILP Workshop on Computer Architecture Competitions (JWAC-5): Championship Branch Prediction (CBP-5)**. A. SEZNEC.
[45] **5th JILP Workshop on Computer Architecture Competitions (JWAC-5): Championship Branch Prediction (CBP-5)**. A. SEZNEC.
[36] **International Symposium on Computer Architecture and High-Performance Computing (SBAC-PAD)**. S. KALATHINGAL, S. COLLANGE, B. NARASIMHA SWAMY, A. SEZNEC.
[35] **Design, Automation and Test in Europe**. D. HARDY, I. PUAUT, Y. SAZEIDES.
[48] **30th IEEE International Parallel & Distributed Processing Symposium**. A. SRIDHARAN, A. SEZNEC.

PANAMA Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

Antoine Deleforge (new PANAMA team member), Florence Forbes (MISTIS team) and Radu Horaud (PERCEPTION team) received the 2016 Hojjat Adeli Award for Outstanding Contributions in Neural Systems for their paper [70].

A. Deleforge, F. Forbes, and R. Horaud, "Acoustic space learning for sound-source separation and localization on binaural manifolds," *International journal of neural systems*, vol. 25, no. 01, 2015, https://hal.archives-ouvertes.fr/hal-00960796

The Award for Outstanding Contributions in Neural Systems established by World Scientific Publishing Co. in 2010, is awarded annually to the most innovative paper published in the previous volume/year of the International Journal of Neural Systems.

PARIETAL Project-Team (section vide)

PARKAS Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

4.1.1. Awards

Marc Pouzet won the Inria/French Académie des Sciences/Dassault Systèmes Innovation award.

PARSIFAL Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

D. Miller gave invited talks at the following two regularly held international meetings.

- TYPES 2016: 22nd International Conference on Types for Proofs and Programs (Novi Sad, Serbia, 23-26 May 2016) and
- Linearity 2016: 4th International Workshop on Linearity (Porto, 25 June 2016).

D. Miller gave invited talks at the following research oriented meetings.

- Workshop on linear logic, mathematics and computer science as part of "LL2016-Linear Logic: interaction, proofs and computation", 7-10 November 2016, Lyon. France.
- Research seminar titled "Interactions between logic, computer science and linguistics: history and philosophy", Université de Lille 3, 15 June 2016.
- CIPPMI (Current issues in the philosophy of practice of mathematics and informatics) Workshop on Proofs, justifications and certificates. 3-4 June 2016, Toulouse, France.

A seminar in honor of the 60th birthday of Professor Miller was held on 15-16 December at Université Paris Diderot-Paris 7 in Paris, France. Several members of the team contributed talks and original research papers.

- Tomer Libal and Marco Volpe, *A general proof certification framework for modal logic*.
- Roberto Blanco and Zakaria Chihani, *An interactive assistant for the definition of proof certificates*. Preprint available as [36].
- Lutz Straßburger, *Combinatorial flows as proof certificates with built-in proof compression*.
- Taus Brock-Nannestad, *Substructural cut elimination*.

B. Accattoli gave an invited talk at the following regularly held international meeting.

- WPTE 2016: 3rd International Workshop on Rewriting Techniques for Program Transformations and Evaluation (Porto, 23 June 2016).

S. Graham-Lengrand gave an invited talk at the following international conference.

- CLAM 2016: 5th Latin American Congress of Mathematicians, thematic session on Logic and Computability (Barranquilla, Colombia, 15th July 2016).

PERCEPTION Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

- **The three-year FP7 STREP project *Embodied Audition for Robots* successfully terminated in December 2016**. The project has addressed the problem of robot hearing, more precisely, the analysis of audio signals in complex environments: reverberant rooms, multiple users, and background noise. In collaboration with the project partners, PERCEPTION contributed to audio-source localization, audio-source separation, audio-visual alignment, and audio-visual disambiguation. The humanoid robot NAO has been used as a robotic platform and a new head (hardware and software) was developed: a stereoscopic camera pair, a spherical microphone array, and the associated synchronization, signal and image processing software modules.
- This year, PERCEPTION started a one year collaboration with the **Digital Media and Communications R&D Center, Samsung Electronics** (Seoul, Korea). The topic of this collaboration is *multi-modal speaker localization and tracking* (a central topic of the team) and is part of a strategic partnership between Inria and Samsung Electronics.

4.1.1. Awards

- **Antoine Deleforge** (former PhD student, PANAMA team), **Florence Forbes** (MISTIS team) and **Radu Horaud** received the **2016 Award for Outstanding Contributions in Neural Systems** for their paper: “Acoustic Space Learning for Sound-source Separation and Localization on Binaural Manifolds," International Journal of Neural Systems, volume 25, number 1, 2015. The Award for Outstanding Contributions in Neural Systems established by World Scientific Publishing Co. in 2010, is awarded annually to the most innovative paper published in the previous volume/year of the International Journal of Neural Systems.
- **Xavier Alameda-Pineda** and his co-authors from the University of Trento received the **Intel Best Scientific Paper Award** (Track: Image, Speech, Signal and Video Processing) for their paper “Multi-Paced Dictionary Learning for Cross-Domain Retrieval and Recognition" presented at the 23rd IEEE International Conference on Pattern Recognition, Cancun, Mexico, December 2016 .

BEST PAPERS AWARDS :
[41] **IEEE International Conference on Pattern Recognition**. D. XU, J. SONG, X. ALAMEDA-PINEDA, E. RICCI, N. SEBE.

PERVASIVE INTERACTION Team (section vide)

PESTO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Steve Kremer gave a keynote talk at the 29th IEEE Computer Security Foundations Symposium (CSF'16).

5.1.1. Awards

Véronique Cortier, Antoine Dallon and Stéphanie Delaune received the EASST best paper award of the ETAPS conference for the paper [24].

BEST PAPERS AWARDS :

[24] **5th International Conference on Principles of Security and Trust (POST'16)**. V. CORTIER, A. DALLON, S. DELAUNE.

PHOENIX Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

- The paper "Designing Parallel Data Processing for Large-Scale Sensor Orchestration" by Milan Kabac and Charles Consel received a Best Paper award at UIC 2016, the 13th IEEE International Conference on Ubiquitous Intelligence and Computing, held in July 2016 in Toulouse, France.
- The web application "It's my life. I choose it!", developed by the Phoenix team in collaboration with the University of Bordeaux (Laboratoire handicap action cognition santé), the University of Mons (Service d'ortho-pédagogie clinique), and the association Trisomie 21 France, received the Universal Accessibility Prize at APAJH 2016, held on November 14th, 2016, in Paris. The web application is available at http://www.monprojetdevie.trisomie21-france.org/.
- The pitch for a startup based on technology from the HomeAssist project received a prize at the "Journée Horizon Startup", held on December, 1st, 2016, in Paris.

BEST PAPERS AWARDS :
[26] **13th IEEE International Conference on Ubiquitous Intelligence and Computing (UIC 2016)**. M. KABÁČ, C. CONSEL.

PI.R2 Project-Team (section vide)

PLEIADE Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Biotechnology

In collaboration with MIAT INRA and UMR 5234 CNRS/Université de Bordeaux, PLEIADE assembled and analyzed *Clavispora lusitaniae*, an ubiquist environmental ascomycetous yeast that can be pathogenic and is responsible for invasive candidiases in pediatric and onco-haematology patients [24].

In collaboration with UMR 5200 CNRS/Université de Bordeaux, PLEIADE assembled and analyzed transcriptomes from three tissues of the oil palm tree *Elaeis guineensis* Jacq., whose mesocarp contains oil up to 90% of its dry weight. Our goal is to increase, by synthetic biology approaches, the yield in oil for crops grown in Europe. The yield and the composition of oil measured from wild-type palm tree specimens varies dramatically, indicating a high level of bio-diversity.

5.1.2. Biodiversity

PLEIADE and the HIEPACS team developed connections between random projection methods and multi-dimensional scaling, in order to compute eigenvectors and eigenvelaues in space of reasonable dimension. The method for MDS developed by Pierre Blanchard has proved to be surprisingly efficient and precise. It was presented at PASC 2016 Lausanne. This work improves the analysis of microbial communities, where the shape of the point cloud built from pairwise distances between a large set of NGS reads is used to describe the diversity of the community.

POEMS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Workshop METAMATH

This event marked the end of the project METAMATH,

funded by the French National Research Agency (ANR). The METAMATH project, led by Sonia Fliss, involved:

- from POEMS, Sonia Fliss, Anne-Sophie Bonnet Ben Dhia, Patrick Ciarlet, Patrick Joly, Camille Carvalho and Valentin Vinoles;

- from DEFI, Lucas Chesnel, Houssem Haddar, Mathieu Chamaillard and Thi Phong Nguyen;

- from Laboratoire Jacques Louis Lions, Xavier Claeys ;

- from IMATH, Université de Toulon, Guy Bouchitté and Christophe Bourel.

The motivation of this project was to contribute to the development of mathematical models for the study of periodic media and metamaterials, which are both physically relevant and available for numerical computations.

The aim of the workshop was to bring together physicists and mathematicians to make an overview of the recent researches and the new perspectives on the field.

The colloquium has taken place at Institut d'études scientifiques de Cargese, near Ajaccio, at Corsica from November 23rd until November 25th. There were about 40 participants.

Workshop on Mathematical and Numerical Modeling in Optics

This workshop, co-organized by Anne-Sophie Bonnet-Ben Dhia, was a part of the yearlong IMA (Institute of Mathematics and Applications) program in Mathematics and Optics, which brings together applied mathematicians, physical scientists and engineers to confront challenging problems arising in optics. It has taken place in Minneapolis from December 12th to December 16th.

It concerned more specifically researchers interested in the mathematical and numerical modeling of optical phenomena, especially spectral problems arising in photonics involving dispersion relations and band structures, eigenfunctions, and scattering resonances. Specific areas of focus included: (i) efficient computational methods for scattering and spectral problems and (ii) properties and optimal design of extreme materials and photonic devices. These problems arise in the study of photonic crystals and periodic media, diffraction gratings, metamaterials, graphene and related materials with Dirac points, and cloaking devices.

There were about 70 participants.

POLARIS Team (section vide)

POLSYS Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

The goal of the RISQ project is to prepare the security industry to the upcoming shift of classical cryptography to quantum-safe cryptography. The RISQ project is a massive effort at the French level to embrace the quantum-safe revolution. The project gather 15 partners : ANSSI, C&S, CEA, Crypto Experts, EADS, ENS Lyon, ENS Paris, Gemalto, Orange, PCQC, POLSYS (Inria de Paris), Université de Rennes, Secure IC, Thales CS, and Université de Versailles.

The RISQ project is certainly the biggest (in term of number of partners, as well as funding) industrial project ever organized in quantum-safe cryptography. RISQ is one of few projects accepted in the "Grands Défis du Numérique" which is managed by BPI France, and will be funded thanks to the PIA.

POLSYS actively participated to gather the partners of RISQ, and in defining the proposal. POLSYS will lead the academic effort in RISQ.

Jointly with LAAS (D. Henrion, S. Naldi), we have released a new MAPLE library SPECTRA for finding a real point $x = (x_1, ..., x_n)$ such that the symmetric matrix $A(x) = A_0 + A_1\, x_1 + \cdots + A_n\, x_n$ is positive semidefinite using exact arithmetic (see http://homepages.laas.fr/henrion/software/spectra/).

Our open source C library SLV has been officially released this year with a presentation at ISSAC. It aims at solating and approximating the real roots of univariate polynomials with integer coefficients (see http://www-polsys.lip6.fr/~elias/soft.html)

4.1.1. Awards

Matías Bender received the Distinguished Student Author Award of ISSAC2016 for his paper [22] written with J.-Ch. FAUGÈRE, L. PERRET and E. TSIGARIDAS.
BEST PAPERS AWARDS :
[22] **ISSAC '16 - 41st International Symposium on Symbolic and Algebraic Computation**. M. R. BENDER, J.-C. FAUGÈRE, L. PERRET, E. TSIGARIDAS.

POSET Team

5. Highlights of the Year

5.1. Highlights of the Year

An α-version of the T-calculus [21] have been released [0].

It has been experimented in an Art & Science project [0] that have illustrated its expressiveness and simplicity for describing reactive music [19], [23]. This Art & Science project will be "on stage" in february 2017 via a "Duo solo for piano and computer".

The software *i-score* have also been further experimented [24], [16] especially during the visit of Shlomo Dubnov (UCSD) in 2016.

[0] see the T-calculus url
[0] see the Interpolation project

POTIOC Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- ERC Grant "BrainConquest : Boosting Brain-Computer Communication with high Quality User Training" (Fabien Lotte)
- EFRAN project e-tac "Tangible and augmented interface for collaborative learning" (Martin Hachet)
- First book in French about BCI [50] [51] (Fabien Lotte)
- First accessible MOOC on "Accessibilité numérique" https://www.fun-mooc.fr/courses/inria/41012/session01/about (Pascal Guitton)

PRIVATICS Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

In 2014, Jagdish Prasad Achara, Mathieu Cunche and Vincent Roca published with Aurelien Francillon from Eurecom a study on the Wi-Fi permissions used by mobile applications and their privacy implications. Two years after our research was published, the Federal Trade Commission (FTC) reached a $950,000 settlement with InMobi for tracking millions of consumers' locations, including children, without their knowledge. The FTC allege that InMobi abused the WiFi State information on the Android system to track the location of people without their consent, which is exactly what we showed in our research. Its policy prevents the FTC of releasing the sources of its investigations, therefore there is no way to affirm that our research triggered this investigation or was used during this investigation. We can only be sure that we identified a privacy issue that was serious enough to justify an investigation of the FTC and a penalty of $950,000. In addition to this, the company is under surveillance for their privacy behaviour for the next 20 years.

4.1.1. Awards

The software `MyTrackingChoices` designed by Claude Castellucia and Jagdish Prasad Achara from Privatics in collaboration with Javier Parra (former member of Privatics and now at Universitat Politecnica de Catalunya) was awarded 'Data protection by design' award by the Catalan Data Protection Authority.

PROSECCO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

This year, we published 18 articles in international peer-reviewed journals and conferences, including papers in prestigious conferences such as POPL, IEEE S&P Oakland, ACM CCS, NDSS, CSF, and WPES. Notably, Bruno Blanchet published a book surveying the use of ProVerif, his state-of-the-art protocol verification tool. We also won several research awards for our work, detailed below. Our work also exposed two new attacks, SLOTH and SWEET32, on Transport Layer Security, resulting in security updates and CVEs in popular web browsers and VPN software.

5.1.1. Awards

- Catalin Hritcu was awarded an ERC Starting Grant
- Catalin Hritcu was awarded an ANR Jeune Chercheur/Jeune Chercheuse Grant
- Karthikeyan Bhargavan was awarded an ERC Consolidator Grant
- Karthikeyan Bhargavan and Gaëtan Leurent won a Best Paper award at NDSS 2016
- Karthikeyan Bhargavan, Cedric Fournet, Markulf Kohlweiss, and Alfredo Pironti were awarded the Levchin prize for contributions to Real-World Cryptography
- Karthikeyan Bhargavan was awarded a Microsoft Outstanding Collaborator Award
- Karthikeyan Bhargavan was awarded the Prix Inria – Académie des sciences du Jeune chercheur

QUANTIC Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Pierre Rouchon was a plenary speaker at 55th IEEE Conference on Decision and Control.
- First demonstration of a quantum error correcting code extending the lifetime of a quantum bit: this experiment performed at Yale in collaboration with the team of Robert J. Schoelkopf realizes the hardware-efficient quantum error correction protocol that we had proposed a few years ago. This is the first experiment where a redundant encoding of quantum information, together with continuous measurements of an error syndrome and real-time closed-loop error corrections, extend the lifetime of the encoded information beyond the best physical part. This result was published in Nature [22].
- An experimental marriage of two central concepts of mechanics, the Schrödinger cat states and the entanglement, was realized in collaboration with the team of Robert J. Schoelkopf at Yale. Following our earlier theoretical proposals, an entangled Schrödinger cat state of light shared between two boxes (two high-Q cavities) were successfully achieved and measured. Experimental realization of such states of light were proposed more than 20 years ago and have important applications in quantum information processing. This result was published in Science [28] and has attracted important press converge around the world.
- First experimental demonstration of the quantum-state diffusion associated with spontaneous emission that triggered the field of quantum trajectories in the 1990s. This result was published in Phys. Rev. X [16]. This also led us to implement a first experimental demonstration of multi-input multi-output (MIMO) feedback in the quantum regime. This result was published in Phys. Rev. Lett. [15].

RAP Project-Team (section vide)

RAPSODI Team

5. Highlights of the Year

5.1. Highlights of the Year

The paper [31], written by Giacomo Dimarco, Raphaël Loubère, Jacek Narski and Thomas Rey presents a new deterministic numerical scheme for the resolution of the full 7d Boltzmann equation. The scheme combines a robust and fast method for treating the transport part based on an innovative Lagrangian technique supplemented with fast spectral solvers to treat the collision operator. This approach along with several implementation features related to the parallelization of the algorithm permits to construct an efficient simulation tool which is numerically tested against exact and reference solutions on classical problems arising in rarefied gas dynamics.

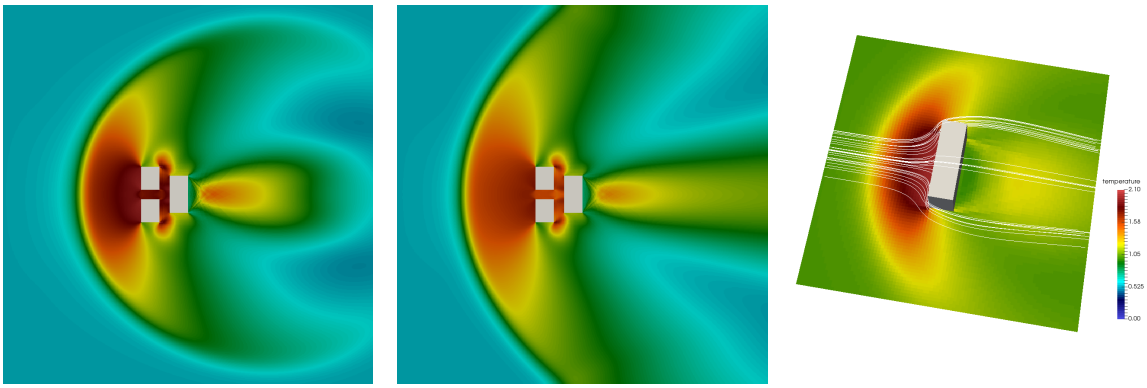


Figure 1. Simulation of a space shuttle atmospheric reentry (pictures from [31])

The paper presents results up to the very challenging 3D×3D case for unsteady flows arising during a space shuttle atmospheric reentry (which was simulated in the deterministic case in the paper for the first time up to our knowledge), which may serve as benchmark for future comparisons between different numerical methods for solving the multidimensional Boltzmann equation. For this reason, the paper also provide for each problem studied details on the implementation, computational cost and memory consumption as well as comparisons with the more standard BGK model or the limit model of compressible Euler equations.

REALOPT Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

The Inria Innovation Lab with Ertus-consulting has reached the state of outputing a strategic planner for phytosanitary treatements in viticulture, showing significant potential saving margins. The prototype was presented to the press and the wine-making industry in September 2016. This event has been followed by some articles in the specialized press (such as “Réussir Vigne”) and more generalist output (such as “Les Echos”). Industrial partnerships are being pursued with EDF (on nuclear maintenance planning) and Saint Gobain (on glas cutting optimization) and a new project has been launched with SNCF.

François Clautiaux published a book [24] about dual-feasible functions, their use to improve the resolution of several combinatorial optimization problems involving knapsack inequalities like cutting and packing, scheduling, and vehicle routing problems, and their strong links with column generation models and the underlying Dantzig-Wolfe decomposition. This book explores the general properties that identify the best dual-feasible functions, describes the general approaches that can be followed to derive new non-dominated functions, which leads on several problems to the best results reported in the literature.

Our research on decomposition based math-heuristics has led to new benchmarks, highlighting the performance of our generic procedures: for instance, we have managed to improve the best known solutions for several open Generalized Assignment Problem (GAP) instances of the litterature. Similarly, our algorithms based on aggregation and disaggregation techniques [6] allowed us to outperform previous approaches for the cutting-stock problem, which is a classical benchmark problem. On the most difficult instances to date, we were able to solve optimally 240 instances out of 250, whereas previous algorithms were only able to solve 29 instances. In a more practical setting, we have developed algorithms to compute team schedules for a roster of employees [9], and these algorithms are now embedded in a professional employee scheduling software of the Asys company. We have also obtained strong results for scheduling problems in a high performance computing context [27], [19], which allowed to significantly improve the performance of linear algebra routines on high-end heterogeneous systems.

REGAL Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

- We initiate a collaboration with ICL Lab (University of Tennessee) to study failure detection in Exascale computing. We designed and evaluated a new robust failure detector. This result is published at SC 2016 [26].

REO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

An important industrial partnership has been signed with the start-up companies Kephalios and Epygon, for the mathematical modeling of implantable cardiac devices.

RITS Project-Team (section vide)

RMOD Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Release of Pharo 5.0

We released a new version Pharo (Pharo 5.0) completly revisited with fundamental changes in the VM (object representation, compiler, ...)

5.1.2. HDR defenses

Anne Etien defended her HDR thesis.

5.1.3. Pharo web for the enterprise

A new book on Pharo.

5.1.4. Guillermo Polito hired as a CNRS engineer

Guillermo Polito a former PhD student in RMod was hired as a CNRS research engineer. This acknolewdges the quality of his research and work.

ROMA Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Anne Benoit was the program chair of HiPC 2016 and the Algorithm-track vice-chair for SC'16.

5.1.1. Awards

- Yves Robert was awarded the *2016 Outsanding Service Award* of the *IEEE Technical Committee on Parallel Processing* (TCPP)

SECRET Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Post-quantum symmetric cryptanalysis

We have been considering the problem of symmetric cryptography in the future environment that will see the arrival of quantum computers. Indeed, this environment will pose a real problem for the majority of asymmetric primitives, but little is known about the implications for the security of symmetric primitives. Confidence in our symmetric primitives is entirely based on our knowledge within the field of cryptanalysis, but in reality, we do not know much about the symmetric post-quantum attacks. If we want post-quantum systems to be reliable and efficient, we need to understand how adversaries might exploit this new computing power. This year, two preliminary results have been obtained within the team and published at CRYPTO 2016 [51] and in the *IACR Transactions on Symmetric Cryptology* [23]. They include surprising results demonstrating that, in some scenarios, some symmetric systems can also become vulnerable to the quantum computer. Recently María Naya-Plasencia has been awarded an ERC starting grant, QUASYModo, to work on this subject. This grant will enable us to continue this work in more depth.

5.1.2. Real-word impact of some theoretical cryptanalytic works

Weak cryptography can be used long after weaknesses have been found by the academic community. For instance, Rogaway warned that the predictable IV used in TLS was a problem in 2002, but it took a public demonstration with a practical exploit in 2011 (the BEAST attack) for servers and clients to implement countermeasures. The same happened with the use of compression (CRIME), unsecure version fallback (POODLE), and known biases in RC4 (RC4NOMORE), to name a few examples. In joint works at NDSS and ACM CCS, K. Bhargavan from the PROSECCO project-team and G. Leurent showed two almost practical attacks against deprecated cryptographic primitives that are still used in real-world applications. The SLOTH attack targeted the use of MD5 in TLS for in-protocol signatures, and the Sweet32 attack targeted the use of 64-bit block ciphers: Blowfish in OpenVPN, and 3DES in TLS. Moreover, the SLOTH attack received a distinguished paper award at NDSS.

5.1.3. Symmetric ciphers for homomorphic encryption schemes

In order to avoid the (extremely) high expansion rate of homomorphic encryption, a solution consists in transmitting to the server the ciphertext c obtained by encrypting m with a symmetric scheme (the corresponding secret key encrypted by the homomorphic cipher is also transmitted). The server then needs to compute m encrypted with the homomorphic scheme from c, i.e. the server needs to homomorphically evaluate the decryption circuit of the symmetric cipher. Hybrid encryption schemes dedicated to this application then require the use of symmetric ciphers with very specific features. Our team has two important contributions on this topic: the design of new appropriate solutions based on stream ciphers [44], and the attack of a cipher proposed by Méaux et al. in this context [48], [32].

5.1.4. Awards

BEST PAPERS AWARDS :

[58] **Post-Quantum Cryptography - 7th International Workshop, PQCrypto 2016**. A. PHESSO, J.-P. TILLICH.

[41] **Network and Distributed System Security Symposium – NDSS 2016**. K. BHARGAVAN, G. LEURENT.

SELECT Project-Team (section vide)

SEMAGRAMME Project-Team (section vide)

SEQUEL Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Grill, Valko & Munos gave an oral presentation at NIPS. Oral presentations at NIPS are rare: out of 2500+ submissions, only 1.8% are presented orally.
- Using a deep learning approach (sparse denoising autoencoders), Strub, Mary & Gaudel have obtained the best ever published results on the data from the Netflix challenge on recommendation systems. 10 years ago, such an achievement was worth 1M$.

SERENA Team (section vide)

SERPICO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. New projects

The 4 year-ANR-DALLISH proposal (PRC / Challenge 7 / Topic 5), coordinated by the Serpico Team-Project, has been accepted in September 2016.

The CytoDI Associated Team, in collaboration with University of Texas, SouthWestern Medical Center, Dallas (TX, USA) started in January 2016.

SIERRA Project-Team (section vide)

SIROCCO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

C. Guillemot has been granted an ERC advanced grant for a project on computational light fields imaging.

SISTM Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Modeling clinical trials of IL7

We have published the results of two clinical trials [17] that are showing the feasability of repeating IL-7 cycles and confirmed the predictions performed with our dynamical model published in [49]. This mecanistic modeling allow to propose protocol which decrease the number of injection within each IL-7 cycle while keeping the same efficacy [35].

Awards Mélanie Prague published an invited paper on her PhD works (which was supervized by Daniel Commenges and co-suppervized by Rodolphe Thiébaut) as a perks for the attribution of the "Marie-Jeanne Laurent-Duhamel PhD award (2015) by the SFdS (Société Francaise de statistiques). [15]

SMIS Project-Team (section vide)

SOCRATE Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

- The SPIE group's digital services subsidiary, and INSA Lyon announce their joint inauguration of a teaching and research chair in the Internet of Things (IoT). Backed by the CITI laboratory (Centre of Innovation in Telecommunications and Integration of service), this chair is being set up within the context of the future technological and social upheaval entailed by the Internet of Things. It will closely involve the skills of the laboratory within the IoT theme and will aim to develop and promote the know-how of SPIE ICS, the first digital services provider to appoint a chair, and INSA Lyon, through a research program aimed at innovation. Jean-Marie Gorce will be responsible for administration the chair funding within the Citi lab.
- The numap memory profiling library (developped in the team during Manuel Selva's PhD work) has been officially integrated into the Turnus dataflow profiler. Turnus [54] is a profiler dedicated to dynamic dataflow programs.
- Samir M. Perlaza and Selma Belhadj Amor delivered the tutorial **"Simultaneous Energy and Information Transmission"** in: (a)**International Conference on Telecommunications** (ICT), Thessaloniki, Greece, May, 2016; (b)**International Conference on Cognitive Radio Oriented Wireless Networks** (CROWNCOM), Grenoble, France, May, 2016; (c)**European Wireless Conference** (EW), Oulu, Finland, May, 2016, together with Ioannis Kikridis (University of Cyprus, Cyprus).

SPADES Project-Team (section vide)

SPECFUN Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

4.1.1. Awards

Pierre Lairez has received the *ISSAC Distinguished Paper Award* for his joint work with T. Vaccon on p-adic differential equations [58].

SPHINX Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

The CANUM ("Congrès d'Analyse Numérique", Conference on Numerical Analysis) is the major French-speaking conference on numerical analysis and scientific computing. It is held since 1967 (every year from 1967 to 2000, every two years from 2000). In 2016, the Institut Élie Cartan de Lorraine was in charge of the organization. Most of the members of our team were involved throughout the year. In particular, Karim Ramdani was head of the organizing committee.

SPIRALS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Makitoo, the start-up company founded by Martin Monperrus and Nicolas Petitprez received the Bpifrance *Création d'entreprise innovante* award, which is a major award in France for startup companies, in the category *Création-développement*.

Makitoo won also a NETVA award from the French ministry of foreign affairs in order to develop its activities in the USA.

Romain Rouvoy has been awarded a Institut Universitaire de France (IUF) junior fellowship for 5 years (2016-21). IUF is an excellence award that is only granted to the top 2% of faculty members in French universities. The award recognizes the excellence of the research activities conducted by Romain Rouvoy.

Laurence Duchien has been elected for a 2-year term in the executive committee of the IEEE Technical Council on Software Engineering (TCSE). The IEEE TCSE helps advance software engineering research and practice. The executive committee determines TCSE policy and the nature of TCSE activities.

STARS Project-Team (section vide)

STEEP Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

This year represents an important landmark in the life of the team, who witnessed the first PhD defense since it has been formed.

The thesis of Jean-Yves Courtonne beared on ecological accounting, with the inception and implementation of a new downscaling method allowing us to track material flow through supply chains at various nested geographical scales; the method also provides an assessment of the associated environmental pressures and an analysis of the errors of the process. This thesis has been recognized by the two referees as a major step forward in France in this field. Four articles have come out of this work; they are published or considered for publication in the leading journals in the field.

A second PhD defense took place this year, by Laurent Gilquin who did most of his PhD studies in STEEP before he followed his supervisor (E. Arnaud) to the AIRSEA project-team.

STORM Team (section vide)

SUMO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Start-up creation. Christophe Morvan (Ass. Prof. Univ. Paris Est Marne la Vallée) has been hosted by Sumo for several years for his research activities. In 2016, he created Open Agora with two other computer scientists. The company develops a software suite to help the decision process in large structures. It offers tools to structure discussions, voting mechanisms, and automated argument summaries. The company will maintain connections with the team for the development of GAGs (Guarded Attributed Grammars) that are instrumental in the automated summary tools.

New team member. Nicolas Markey (DR CNRS) recently joined the team, after several years in LSV (*Laboratoire Spécification et Vérification*), Cachan. Nicolas will reinforce the activities of the team in the modeling and analysis of timed systems, abstraction techniques and game theory.

TACOMA Team (section vide)

TADAAM Team

5. Highlights of the Year

5.1. Highlights of the Year

The NETLOC (See Section 6.1) tools have been run on one of the largest European supercomputers (the TGCC/Genci CURIE machine) and successfully modeled its 5200 nodes and its interconnection network (more than 800 switches). This is a joint work with CEA and the COLOC European project.

TAMIS Team

5. Highlights of the Year

5.1. Highlights of the Year

New major release of Plasma Lab

Participants: Axel Legay, Sean Sedwards, Louis-Marie Traonouez.

We have released version 1.4.0 of our Plasma Lab software. This new version introduces a new command line interface for launching Plasma Lab. Besides the Graphical Interface, most of Plasma Lab functionalities are now available directly from the command line. Additionally the new version includes a new algorithm for cross entropy minimization using importance sampling. It allows to estimate the probabilities of rare events.

Fault injection proof-of-concept

Participants: Axel Legay, Jean-Louis Lanet, Thomas Given-Wilson, Nisrine Jafri.

Creation of a proof of concept to show that formal verification can be used to discover fault injections induced by hardware attacks.

Creation of LHS platform

Participants: Jean-Louis Lanet, Hélène Le Bouder, Ronan Lashermes.

Entry into service of the LHS platform that can be used to monitor systems, inject faults, or reason on ransomware.

Taler Systems startup creation

Participants: Jeffrey Burdges, Florian Dold, Christian Grothoff, Marcello Stanisci.

A startup, Taler Systems S.A. was formally created, and we started the contractual paperwork required. An interview was given to RWGV-Genossenschaftsblatt (an internal publication of a large group of German banks).

Contract with CISCO

Participants: Axel Legay, Fabrizio Biondi, Thomas Given-Wilson.

Signature of a major research collaboration contract between Tamis and CISCO to work on malware analysis. The collaboration will fund 3 engineers, trips to visit CISCO and participate to conferences on the topic, as well as a powerful servers to store and analyse malware.

Awards

Axel Legay received the first Parnass award.

Christian Grothoff became an Ashoka fellow.

TAO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Yann Ollivier was invited to contribute to Yann LeCun's official series of talks on Deep Learning at College de France.
- Isabelle Guyon was program chair of the NIPS 2016 conference (in 2017 she will be general chair).
- The TAO team was selected by Microsoft to become the community lead of the competition plaform Codalab. We received a $20 000 Azure for research grant.
- Paola Tubaro co-organized the Second European Social Networks (EUSN) Conference, a major interdisciplinary event for the international research community interested in social networks. Jean-Daniel Fekete (AVIZ) was keynote speaker, and some TAO members contributed papers.

TAPDANCE Team

4. Highlights of the Year

4.1. Highlights of the Year

TAPDANCE Team created in June 2016.

A Starting Research Fellow, Pierre-Étiene Meunier, was hired by Inria to begin work with TAPDANCE in January 2017.

TASC Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

Award at the MiniZinc Challenge 2016 solver competition in the Fixed category (Bronze). The aim of the challenge is to start to compare various constraint solving technology on the same problems sets. The focus is on finite domain propagation solvers. An auxiliary aim is to build up a library of interesting problem models, which can be used to compare solvers and solving technologies.

TEA Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

In 2016, TEA was successfully evaluated, one year after its creation. The team started fruitful collaborations with UC San Diego, with Mitsubishi R&D, with ASTRI, to elaborate our research program on system composition, verification, and simulation toward novel applications perspectives in codesign, operating system design, factory automation, robotics.

THOTH Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

- Cordelia Schmid received the Humboldt Research Award, granted by the Alexander von Humboldt Foundation.
- Cordelia Schmid was awarded the Longuet-Higgins Prize at CVPR 2016 for the paper co-authored with Svetlana Lazebnik (University of Illinois at Urbana-Champaign) and Jean Ponce (ENS Paris/Inria) entitled "Beyond bags of features: spatial pyramid matching for recognizing natural scene categories".
- Cordelia Schmid was awarded the Inria - Académie des Sciences Grand Prize 2016.
- Thoth is one of the recipients of a hardware donation in the Facebook AI Research Partnership Program.
- Julien Mairal was awarded one of the ERC starting grants 2016.

TITANE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

We obtained a Proof of Concept grant from the European Research Council, entitled TITANIUM (Software Components for Robust Geometry Processing). The TITANIUM project aims to develop a software demonstrator for geometry processing and 3D urban modeling, in order to facilitate the pre-commercialization of novel software components for the Computational Geometry Algorithms Library. The demonstrator will include novel approaches resulting from the ERC-funded IRON project.

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BEST PAPERS AWARDS :
[] **Computer Graphics Forum**. Z. SHI, P. ALLIEZ, M. DESBRUN, H. BAO, J. HUANG.

TOCCATA Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- S. Conchon: co-organizes POPL'2017 (January, Paris, http://conf.researchr.org/home/POPL-2017)
  - Major Int. Conference on Foundations of Programming Language, Semantics, Type Systems, Formal Proof Techniques

5.1.1. Awards

- [April 2016] Martin Clochard, Léon Gondelman, Mário Pereira: jointly receive the "Best student team" award of the *VerifyThis@ETAPS2016 verification competition*
- [July 2016] S. Boldo: Best Talk Award at workshop NSV *Computing a correct and tight rounding error bound using rounding-to-nearest*

TONUS Team (section vide)

TOSCA Project-Team (section vide)

TROPICAL Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

- The Gaspard Monge Programme for Optimization and Operations Research (PGMO), a corporate sponsorship of EDF operated by Fondation Mathématique Jacques Hadamard, coordinated by Stéphane Gaubert, received the “Grand Prix AEF – meilleures initiatives partagées Universités Entreprises”.
- Mateusz Skomra received the Dodu prize (distinction for the best talk of a young researcher) at the conférence SMAI-MODE 2016.

TYREX Project-Team (section vide)

URBANET Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

The paper by A. Boubrima *et al.* - "Cost-Precision Tradeoffs in 3D Air Pollution Mapping using WSN" received the Best Paper Award at the 2nd International Symposium on Ubiquitous Networking (UNET 2016).

Ahmed Boubrima was awarded the third place in the Best MS Thesis competition by IEEE ComSoc Chapter Francefor his work on optimal deployment of wireless sensor networks to monitor urban pollution (supervised by Walid Bechkit and Hervé Rivano).

BEST PAPERS AWARDS :

[13] **UNET 2016 - 2nd International Symposium on Ubiquitous Networking**. A. BOUBRIMA, W. BECHKIT, H. RIVANO, L. SOULHAC.

VEGAS Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

Inria signed a contract for the integration of ISOTOP within Maple.

The project-team VEGAS will terminate at the end of 2016. A new project-team GAMBLE (Geometric Algorithms and Models Beyond the Linear and Euclidean realm) is currently submitted. It intends to extend computational geometry to non-linear objects, non-Euclidean spaces and probabilistic complexities.

VERIDIS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Jasmin Blanchette was awarded an ERC Starting Grant for his Matryoshka project aiming at fast interactive verification through strong automation for higher-order constructs.

As part of a European network, Pascal Fontaine and Thomas Sturm participate in a new H2020 Coordination and Support Action. [0] In accordance with the distributed character of Veridis, we are operating nodes at LORIA as well as MPI. Further nodes are located in Austria (University of Linz), Germany (RWTH Aachen; University of Kassel), Italy (Fondazione Bruno Kessler; University of Genova), and the UK (Universties of Bath, Coventry, and Oxford; Maplesoft Europe Ltd.). The CSA aims at improving the integration of communities, methods, and software from SMT solving and symbolic computation [20].

Jasmin Blanchette and Stephan Merz were PC chairs and organizers of the 7th International Conference on Interactive Theorem Proving in Nancy (August 22–27), the main conference of developers and users of proof assistants.

5.1.1. Awards

Mathias Fleury, together with his two supervisors, received the Best Paper Award at IJCAR 2016 for their work on a formalized SAT solver.

Together with Andrew J. Reynolds at the University of Iowa, Jasmin Blanchette was invited to submit a short version of his CADE 2015 paper on a decision procedure for (co)datatypes to the Sister Conference Best Paper Track of IJCAI 2016.

BEST PAPERS AWARDS :

[25] **8th International Joint Conference on Automated Reasoning (IJCAR 2016)**. J. C. BLANCHETTE, M. FLEURY, C. WEIDENBACH.

[19] **IJCAI 2016**. A. REYNOLDS, J. C. BLANCHETTE.

[0] H2020-FETOPEN-2015-CSA-712689, http://www.sc-square.org/

VIRTUAL PLANTS Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

- *Stochastic model of Phyllotaxis*: Exploration of developmental mechanisms classically relies on analysis of pattern regularities. Whether disorders induced by biological noise may carry information on building principles of developmental systems is an important debated question. In this work, we addressed theoretically this question using phyllotaxis, the geometric arrangement of plant aerial organs, as a model system. Phyllotaxis arises from reiterative organogenesis driven by lateral inhibitions at the shoot apex. Motivated by recurrent observations of disorders in phyllotaxis patterns, we revisited in depth the classical deterministic view of phyllotaxis. We developed a stochastic model of primordia initiation at the shoot apex, integrating locality and stochasticity in the patterning system. This stochastic model recapitulates phyllotactic patterns, both regular and irregular, and makes quantitative predictions on the nature of disorders arising from noise. Altogether, we show that disorders in phyllotaxis instruct us on the parameters governing phyllotaxis dynamics, and thus that disorders can reveal biological watermarks of developmental systems [27].
- *Statistical methods*: One of our main activities consists of identifying and characterizing developmental patterns in plant phenotyping data. Phenotyping data are very diverse ranging from the tissular to the whole plant scale but are often highly structured in space, time and scale. We intend to analyse such data using state-of-the-art methods at the crossroad between statistical modelling, machine learning and pattern recognition. This generates regularly new methodological results as illustrated this year by [18] and [25].

VISAGES Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

- In 2015, the Neurinfo platform obtained an “Emergence” label from the IBISA agency, this label has been upgraded in 2016 as a “platform of Excellence” and sustained by IBISA in 2016 and onward. The IBISA label is a national label for technological platforms awarded by the GIS IBISA on an annual basis.

WHISPER Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

The main highlight of the year is the continuous spreading of Coccinelle within the developer community of the Linux kernel. We submitted the first patches to the Linux kernel based on Coccinelle in 2007. Since then, over 4500 patches have been accepted into the Linux kernel based on the use of Coccinelle, including around 3000 by over 500 developers from outside our research group. Another testimonial of the impact of our work is the signature of a Memorendum Of Understanding (MOU) with the Linux Foundation. As part of the MOU, Greg Kroah-Hartman will spend a year with Whisper starting in October 2016. Kroah-Hartman is one of the leading developers of the Linux kernel, and is one of only a few developers employed by the Linux Foundation, with another being Linus Torvalds. Greg participated in the activities of the Whisper team around the use of Coccinelle and research projects related to the Linux kernel, and he is a convinced ambassador of our research work.

Our work on Remote Core Locking (RCL) [10] was accepted in ACM Transaction in Computer Systems (TOCS) which is the most prestigious journal in systems. RCL is currently one of the most efficient locks for multicore architectures.

WILLOW Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

- Jean Ponce (together with Svetlana Lazebnik and Cordelia Schmid) received the Longuet-Higgins Prize for “Fundamental contributions in Computer Vision", awarded at the IEEE Conference on Computer Vision and Pattern Recognition, 2016.

WIMMICS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards & Nominees

The Wimmics team received collectively the Université Côte d'Azur Award in recognition of the ISWC best demo.

Best demo award at ISWC for *Semantic Web Technologies for improving remote visits of museums, using a mobile robot* [32].

Best poster nominee at ISWC for *Materializing the Editing History of Wikipedia as Linked Data in DBpedia* [60].

Michel Buffa was finalist for the first-ever edX Prize for Exceptional Contributions in Online Teaching and Learning (11 teachers have been selected among 2500 others and 1200 online courses) for his MOOCs on HTML5.

Valerio Basile was awarded the first prize, granted by IBM, at the *Evaluation of NLP and Speech Tools for Italian (Evalita)* workshop.

XPOP Team

5. Highlights of the Year

5.1. Highlights of the Year

R Foundation

Julie Josse has been elected member of the R Foundation for Statistical Computing.

mlxR 3.1

mlxR 3.1 available on CRAN

ZENITH Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- The Pl@ntNet application, developed by Zenith and its partners, is enjoying a huge success: more than 2.7M downloads as in November 2016 in 150 countries; the number of users doubles every 6 months; tens of thousands of users each day, 12% being professionnals in agriculture or education.
- Alexis Joly and his collaborators of the Pl@ntNet project have been awarded the prize “La Recherche 2016” organized by the French magazine La Recherche for the article [2].