Activity Report 2014

Section Highlights of the Team

ABS Project-Team

5.1. Highlights of the Year

In 2014, two achievements are worth noticing:

Analysis of large assemblies using native mass spectrometry data. Native mass spectrometry is about to revolutionize structural biology, since such experiments give access to the composition in terms of subunits of large macro-molecular assemblies, usually beyond reach for classical experimental techniques. In this context, we designed an algorithm to infer pairwise contacts within subunits of large macro-molecular assemblies – see section 5.3.1 . To the best of our knowledge, our algorithm is the only one whose performances can be precisely analyzed, the contenders being of heuristic nature.

Analysis and comparison of conformational ensembles and sampled energy landscapes. A key property governing the behavior of many biophysical systems is the classical enthalpy - entropy balance, which is the root of thermodynamics. Therefore, studying the way a protein folds or the way two proteins assemble requires unveiling properties of ensembles of conformations of the system scrutinized. In this context, we designed novel methods to analyze and compare collections of conformations and the associated energy landscape – see section 5.4.1 . The algorithms are based on state-of-the-art techniques from computational topology (Morse theory, Morse homology), and optimal transportation.

ALF Project-Team

6.1. Highlights of the Year

André Seznec and Pierre Michaud won the 4th Championship Branch Prediction in all the 3 categories, 4KB, 32 KB and unlimited storage predictors [23], [33], thus confirming the past championships in 2011, 2006 and 2004.

ALGORILLE Project-Team (section vide)

ALICE Project-Team

6.1. Highlights of the Year

Fabrication: We proposed a novel technique to automatically generate support structures for additive manufacturing with filament based processes. The deposited filament has to be properly supported at all times, which complicates printing of overhanging shapes: a disposable support has to be generated to temporarily hold the filament deposited above. Existing techniques either generate large structures, wasting material, or generate very thin structures that are hard to print and prone to failure. In contrast, our technique optimizes a scaffolding which is made of vertical pillars and horizontal bridges – such horizontal bridges print properly as long and the filament is deposited in straight line from one pilar to the next. We showed how to formulate scaffolding generation as a minimization problem and proposed a heuristic algorithm based on an efficient plane sweeping approach. The work was published [9] in ACM Transactions on Graphics in 2014 (proceedings of SIGGRAPH 2014). It is integrated within our 3D modeler for additive manufacturing, IceSL.

Optimal transport: this is an active research topics in the mathematics community. Given two measures μ and ν, optimal transport defines a distance between μ and ν, as the minimum cost of "morphing" μ into ν. This distance (called the *Wasserstein distance*) structures the space of measures and offers new ways of solving some highly non-linear PDEs (Monge-Ampere, Fokker-Plank ...). This requires a numerical way of computing the Wasserstein distance and its gradients. We studied a semi-discrete technique [21] submitted to ESAIM J. M2AN), that optimizes power diagrams. This is to our knowledge the first numerical implementation of optimal transport for volumetric densities (computes the Wasserstein distance between a sum of Dirac masses and a piece-wise linear density supported on a tetrahedral mesh).

ALPAGE Project-Team

6.1. Highlights of the Year

Benoit Crabbé is a Junior Member of the Institut Universitaire de France (IUF) since October 2014. Two out of the five academic staff at Alpage are now member of the IUF, Laurence Danlos being a Senior Member since October 2013.

ALPINES Project-Team

6.1. Highlights of the Year

We have released a version of FreeFem++ (v 3.33) which introduces new and important features related to high performance computing:

- Interface with PETSc library
- Interface with HPDDM (see above)
- improved interface with the parallel direct solver MUMPS

This release enables, for the first time, end-users to run the very same code on computers ranging from laptops to clusters and even large scale computers with thousands of computing nodes

AMIB Project-Team (section vide)

ANGE Project-Team

6.1. Highlights of the Year

In 2014, ANGE status turned from Inria team to Inria project-team. Afterwards, M. Parisot was recruited by Inria as a junior researcher.

ANTIQUE Team

6.1. Highlights of the Year

Patrick and Radhia Cousot have received in 2014 the IEEE Computer Society IEEE Computer Society Harlan D. Mills award for the invention of abstract interpretation, developpment of tool support and practical application http://www.computer.org/portal/web/awards/cousots.

AOSTE Project-Team (section vide)

APICS Project-Team (section vide)

ARAMIS Project-Team

6.1. Highlights of the Year

ARAMIS has contributed to the special issue on "Complex network theory and the brain" in the prestigious journal of Philosopical Transactions of the Royal Society, Series B. This work was featured by the ICM (http://icm-institute.org/en/news/complex-network-theory-and-the-brain?lang=en) and Inria (http://www.inria.fr/en/centre/paris-rocquencourt/news/complex-network-theory-and-the-brain).

ARIC Project-Team (section vide)

ASAP Project-Team

6.1. Highlights of the Year

- Anne-Marie Kermarrec is the recipient of the **ACM/IFIP/USENIX/Middleware 10-Years Best Paper Award**, for her paper *The peer sampling service: Experimental evaluation of unstructured gossip-based implementations* (Middleware 2004), co-authored with Márk Jelasity, Rachid Guerraoui, and Maarten van Steen.

- Anne-Marie Kermarrec is the recipient of the **WISE 2014 Best Paper Award**, for her paper [18], co-authored with Alexandra Olteanu and Karl Aberer.

- Michel Raynal is the recipient of the **PODC 2014 Best Paper Award**, for his paper [34], co-authored with Achour Mostefaoui and Moumen Hamouna.

- The MEDIEGO recommendation engine was demonstrated at **Le Web 14** in partnership with FranceTV.

BEST PAPERS AWARDS :

[18] **15th International Conference on Web Information System Engineering (WISE 2014)**. O. ALEXANDRA, A.-M. KERMARREC, K. ABERER.

[34] **ACM PODC**. A. MOSTEFAOUI, M. HAMOUNA, M. RAYNAL.

ASCLEPIOS Project-Team

5.1. Highlights of the Year

- Nicholas Ayache was elected a member of the Académie des sciences on 18th Nov. 2014.
- Nicholas Ayache received the "Grand Prix Inria – Académie des sciences 2014" for his major contributions to Informatics and Computational Sciences at Inria.
- Nicholas Ayache taught the "Personalized Digital Patient" course at the Collège de France on the annual chair "Informatics and Computational Sciences".
- Hervé Lombaert was awarded and ranked 1st in computer science at the highly selective NSERC Postdoctoral Fellowship (Top funding agency in Canada).
- Nina Miolane and Bishesh Khanal won the first prize in the "Popular Vote Awards" at the MIC-CAI 2014 Educational Challenge for their video on "Statistics on Lie groups for Computational Anatomy".

BEST PAPER AWARD :

[12] **MICCAI Workshop on Abdominal Imaging – Computational and Clinical Applications**. C. AUDIGIER, T. MANSI, H. DELINGETTE, S. RAPAKA, V. MIHALEF, D. CARNEGIE, E. BOCTOR, M. CHOTI, A. KAMEN, D. COMANICIU, N. AYACHE.

ASCOLA Project-Team

6.1. Highlights of the Year

Nicolas Tabareau was awarded a starting grant from the European Research Council (ERC), the most prestigious type of research projects of the European Union for young researchers. From 2015–2020 he will pursue research on "CoqHoTT: Coq for Homotopy Type Theory."

Jonathan Pastor has won the joint 1st prize at the Grid5000 Scale challenge, an international challenge for large-scale experiments on geographically-distributed cluster environments. Jonathan has shown with a colleague how to deploy and manage thousands of VMs in such an environment using his approach to fully distributed virtual machine management.

This year we have provided major research results in two domains. First, we have developed several new approaches for the formal reasoning over software in the domains of theorem proving [31], as well as reasoning over distributed interaction protocols [32] and software compositions [24]. Second, we have developed new methods supporting dynamic computations over the cloud, both by means of more elastic cloud applications [27] and better locality management for the dynamic placement of virtual machines in Cloud infrastructures [29].

ASPI Project-Team (section vide)

ATEAMS Project-Team

5.1. Highlights of the Year

- Davy Landman, Jurgen Vinju received a Best paper award nomination, for their paper "Empirical analysis of the relationship between CC and SLOC in a large corpus of Java methods"(ICSM'14).

ATHENA Project-Team

6.1. Highlights of the Year

Maureen Clerc was awarded the Pierre Faurre Prize by the French Academy of Sciences. This award recognizes her outstanding contributions to the modelling and interpretation of electrical signals in the brain. The ceremony took place at the Institut de France on October 14th, 2013.

Emmanuel Caruyer was awarded the AFRIF Best PhD thesis award 2013 for his work "Q-space diffusion MRI: Acquisition and Signal Processing" performed under the direction of Rachid Deriche. He received the award thesis AFRIF 2013 during RFIA Conference held from June 30 to July 4, 2014 in Rouen.

Rachid Deriche was awarded the title of Honorary Doctor (honoris causa) from the University of Sherbrooke, Canada. This award recognises his achievements and contributions to image processing, computer vision and computational brain imaging. The title was awarded at the academic conferment ceremony held on September 20th, 2014 at the University of Sherbrooke.

Théo Papadopoulo has been promoted to the position of Research Director Class 2, starting from October 1st, 2014.

ATLANMOD Project-Team (section vide)

AVALON Project-Team (section vide)

AVIZ Project-Team

6.1. Highlights of the Year

We had a number of highlights this year:

- Jean-Daniel Fekete was General Chair of the IEEE VIS 2014 conference, organized for the first time ever outside of the USA, in Paris, with a record attendance.

- Aviz presented 7 articles at the IEEE VIS 2014 conference, and co-organized 3 workshops.

- Five PhD students defended this year.

- Benjamin Bach was awarded the second price in the IEEE VGTC Doctoral Dissertation Competition for his thesis "Connections, Changes, Cubes: Unfolding Dynamic Networks for Visual Exploration" [10].

- Yvonne Jansen was awarded the second price for the Gilles Kahn dissertation award for her thesis "Physical and Tangible Information Visualization" [11].

- Samuel Huron received the best paper honorable mention award at DIS 2014 for the paper "Constructive Visualization" [28].

AYIN Team

5.1. Highlights of the Year

- Yuliya Tarabalka was nominated CR1 since 1 January 2015.

- Josiane Zerubia was elected for a duration of 6 years at the board of directors of the French Society of Photogrammetry and Remote Sensing (SFPT, http://www.sfpt.fr/).

- Josiane Zerubia was invited by Technion to give a plenary talk at SIMA'14 in Ein Gedi, Israel organized for the 60th birthday of Prof. Alfred Bruckstein in May, http://www.cs.technion.ac.il/SIMA14/.

BACCHUS Team (section vide)

BAMBOO Project-Team (section vide)

BEAGLE Project-Team

5.1. Highlights of the Year

We organized two satellite workshops of international conferences:

- The Aevol tutorial during ALife 2014 (July 30 - August 2, New York) http://www.aevol.fr/alifeTutorial

- The "Computational Methods and Modeling of Astrocyte Physiology and Neuron-Glia Interactions" workshop during the Computational NeuroScience 2014 conference (July 26 - 31, Quebec City, Canada)

These highlight our active presence in the scientific life of our two sub-domains in major conferences.

BIGS Project-Team (section vide)

BIOCORE Project-Team

6.1. Highlights of the Year

- We reanalyzed the so-called Marginal Value Theorem (MVT), first published in 1976, in a paper published in Ecology Letters [23]. This theorem, also used in human behavior and economics, establishes how individuals should behave to optimize resource exploitation. Despite the thousands of papers written on the subject, we obtained the first mathematical characterization of how habitat characteristics affect the optimal foraging strategy. Mathematical foundations for this work were given in [24].

- The analysis of metabolic networks is generally made under the assumption (so called "balanced growth") that there is no internal accumulation of metabolites. However, this hypothesis is clearly wrong for microalgae, which store lipids and carbohydrates during the day and consume it during the night. A new formalism, called DRUM (Dynamic Reduction of Unbalanced Metabolism) was developed [16], assuming that the balanced growth is valid only in subnetworks, but that there can be accumulation between these modules (which often represent spatial distribution in the cell). This approach was successfully used to represent the dynamics of carbon accumulation in the microalgae *Tisochrysis lutea* under light/dark cycles, or in response to a nitrogen starvation. It also well described the diauxic heterotrophic growth of *Chlorella pyrernoidosa* [11].

BIPOP Project-Team

6.1. Highlights of the Year

- Bernard Brogliato: keynote speaker at ICDVC-2014, 4th International Conference on Dynamics, Vibration and Control, August 23-25, 2014 in Shanghai, China. http://www.icdvc2014.org/

BONSAI Project-Team

6.1. Highlights of the Year

- Amandine Perrin received the best paper award and the best oral presentation at the ISCB-LA 2014 international conference for the work on reconstruction of ancestral gene orders.

- Hélène Touzet was invited as a keynote speaker at the ALGO 2014 international conference. The topic of the talk was RNA bioinformatics.

BEST PAPERS AWARDS :

[7] **ISCB-Latin America**. A. PERRIN, J.-S. VARRÉ, S. BLANQUART, A. OUANGRAOUA.

CAGIRE Team (section vide)

CAIRN Project-Team

6.1. Highlights of the Year

Our work on accuracy evaluation and optimisation for fixed point arithmetic was presented during a tutorial "Automatic Fixed-Point Conversion: a Gateway to High-Level Power Optimization" at IEEE/ACM Design Automation and Test in Europe [77].

As a proof of concept of our research on improving efficiency of dynamic reconfiguration in FPGAs [47] [48], the *eFPGA* (Figure 5) chip was designed and fabricated in 65nm CMOS technology. In the proposed and patented architecture [73] (EU patent), the configuration of the FPGA becomes independent from its placement and is moreover significantly compressed (up to ×10). This notion of *Virtual Bit Stream* allows for seamless partial and dynamic reconfiguration and for task migration.
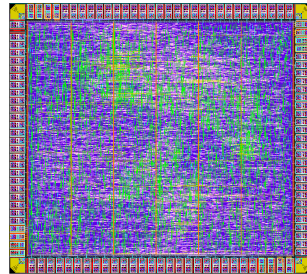
Figure 5. CAIRN*'s eFPGA chip*

CAMUS Team

6.1. Highlights of the Year

One of Philippe Clauss' early papers on Ehrhart polynomials has been celebrated, 18 years later, in a selection of papers for the International Conference on Supercomputing (ICS) 25th anniversary retrospective [13]. 35 papers have been selected among roughly 1800 papers published between 1987 and 2011. The paper is:

"Counting Solutions to Linear and Nonlinear Constraints Through Ehrhart Polynomials: Applications to Analyze and Transform Scientific Programs", by Philippe Clauss, ICS'96, which introduced Ehrhart polynomials in the field of program analysis and optimization.

Philippe Clauss wrote an additional retrospective [12] related to this research which complements the paper in the ICS special issue.

CARAMEL Project-Team

6.1. Highlights of the Year

Razvan Barbulescu, ex-PhD student in the team, has received the award "Prix Le Monde de la recherche universitaire", as one of the top-5 PhD thesis in exact science in 2014.

Emmanuel Thomé has received the "Prix Régional du Chercheur" of the Région Lorraine.

Emmanuel Thomé has received the "Prix de l'Association des Amis de l'Université de Lorraine".

BEST PAPER AWARD :

[17] **Eurocrypt 2014**. R. BARBULESCU, P. GAUDRY, A. JOUX, E. THOMÉ.

CARMEN Team

6.1. Highlights of the Year

- New associated team EPICARD (principal investigator N. zemzemi, Y. Coudière and J. Henry). The aim of of this associated team for the first year is to overcome the technical difficulties that we pointed out during the year 2014 in inverse problem for the heart.

- June 2014: Based on a peer-reviewed proposal, the Grand équipement national de calcul intensif (GENCI) has attributed us 3 million core-hours on the national high-performance computing system Turing, to be used in the year 2014.

- December 2014: Based on a peer-reviewed proposal, the Grand équipement national de calcul intensif (GENCI) has attributed us 3.5 million core-hours on the national high-performance computing machines Turing, Curie, and Occigen, to be used in the year 2015.

- LIRYC will fund a 2-year postdoctoral position on simulation of Brugada syndrome, a rare ECG anomaly predictive of sudden cardiac death in young, apparently healthy subjects. This work will be performed in tight collaboration with clinicians at the Haut-Lévèque hospital

CARTE Project-Team

6.1. Highlights of the Year

Our team made remarkable progress into the understanding of complexity of higher-order functionals. While a robust class of computable functionals exists at any finite type built from $\mathbb{N}$ and $\rightarrow$ (the Kleene-Kreisel functionals), no satisfying complexity classes had been defined so far, except the class BFF of Basic Feasible Functionals. However that class is not a complexity class in the usual sense and does not offer the possibility to define space complexity or non-deterministic time complexity. In his PhD Hugo Férée has developed a non-trivial notion of size for higher-order functionals using game semantics and he has defined a notion of polynomial-time computable functional including BFF but behaving more satisfactorily in several ways. A paper in preparation will gather these results.

CASCADE Project-Team (section vide)

CASSIS Project-Team

6.1. Highlights of the Year

Véronique Cortier was one of the two FLoC plenary speakers during the Vienna Summer of Logic [31].

Steve Kremer and Robert Künnemann got a paper accepted at the 35th IEEE symposium on Security and Privacy [45].

The ANR project SEQUOIA has been accepted.

BEST PAPERS AWARDS :

[43] **Software Security and Reliability (SERE)**. E. FOURNERET, J. CANTENOT, F. BOUQUET, B. LEGEARD, J. BOTELLA.

[47] **The 7th International Symposium on Foundations & Practice of Security FPS'2014**. H. H. NGUYEN, A. IMINE, M. RUSINOWITCH.

CASTOR Project-Team (section vide)

CELTIQUE Project-Team (section vide)

CIDRE Project-Team

6.1. Highlights of the Year

The supervision of distributed system relies heavily on correlation mechanisms that are responsible for collecting alerts coming from sensors and detecting complex scenarios in the flow of alerts. The problem is that it requires to write complex correlation rules. The work we have performed proposes a technique to generate semi-automatically such correlation rules. It describes a process that uses an attack tree and a representation of the system as inputs, and generate a correlation tree that can be translated in an alert correlation description language. This work received the best paper award of SAR-SSI 2014 [50].

One approach to protect the privacy of users in personalized recommendation systems is to publish a sanitized version of the profile of the user by relying a non-interactive mechanism compliant with the concept of differential privacy. In a joint work with Raghavendran Balu and Teddy Furon (LinkMedia Inria team), we have consider two existing schemes offering a differentially private representation of profiles: BLIP (BLoom-and-flIP) and JLT (Johnson-Lindenstrauss Transform). For assessing their security levels, we play the role of an adversary aiming at reconstructing a user profile. To realize this, we design two inference attacks named single and joint decoding. The first inference attack tests the presence of a single item in the profile, and is iterated independently for each possible item of the item set. In contrast, the second inference attack aims at deciding whether a particular subset of items is likely to be in the user profile. This attack is tested on all the possible subsets of items. Our contributions are a theoretical analysis and practical implementations of both attacks tested on datasets composed of real user profiles revealing that joint decoding is the most powerful attack. This also gives useful insights on the setting the differential privacy parameter ϵ. This work has received the best student paper award at the conference ESORICS 2014.

BEST PAPERS AWARDS :

[27] **European Symposium on Research in Computer Security**. R. BALU, T. FURON, S. GAMBS.

CLASSIC Project-Team (section vide)

CLIME Project-Team

6.1. Highlights of the Year

Best Paper Award :

[20] **VISAPP - International Conference on Computer Vision Theory and Applications**. D. Béréziat, I. Herlin.

COAST Team (section vide)

COATI Project-Team (section vide)

COFFEE Project-Team (section vide)

COMETE Project-Team

6.1. Highlights of the Year

- Prix de thèse de l'Ecole Polytechnique 2014 for the thesis "The Epistemic View of Concurrency Theory" by Sophia Knight (Defended 20 September, 2013).
- Catuscia Palamidessi has been invited keynote speaker at the joint conferences CONCUR 2014 and TGC 2014. Rome, September 2014.

COMMANDS Project-Team

6.1. Highlights of the Year

6.1.1. *Optimization of running strategies based on anaerobic energy and variations of velocity*
Participant: Frédéric Bonnans.

The paper [10] about running strategies proves Keller's conjecture. It was highlighted in SIAM Connect,see
http://connect.siam.org/insightful-mathematics-for-an-optimal-run/

6.1.2. *Research and transfer collaboration in aeronautics with the startup Safety Line*
Participants: Frédéric Bonnans, Daphné Giorgi, Stéphan Maindrault, Pierre Martinon.

Following the meeting with the startup Safety Line at Imatch "Optimisation and Control" in october 2013,
we conducted a first collaboration of six months on optimizing the fuel consumption of civil airliners. This
first step successfully established the proof of concept and was validated by actual test flights in June 2014,
leading to a shared patent and the development of a specific module of our software 'Bocop', included in the
tool 'OptiClimb' developed at Safety Line. Future prospects include improving the numerical robustness of
the current tool, as well as expanding the optimization to the cruise flight in addition to the climb phase.
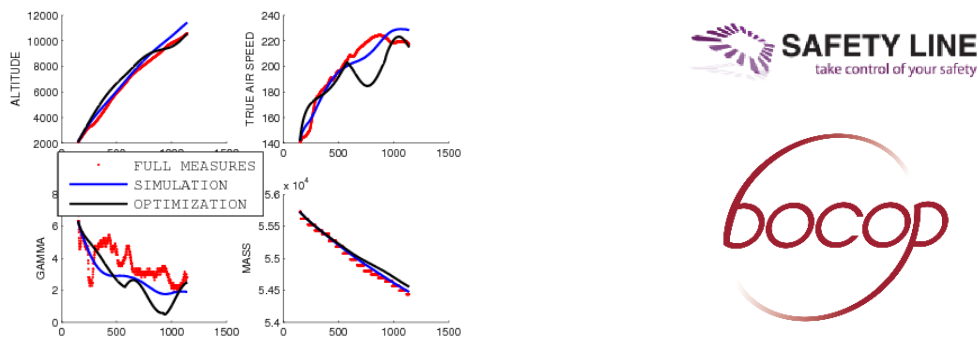
Figure 2. Plane climb phase (Boeing 737)

COMPSYS Project-Team

6.1. Highlights of the Year

For 2014, from the point of view of organization, funding, collaborations, the main points to highlight are:

- Christophe Alias and Alexandru Plesco have co-founded the XTREMLOGIC start-up in January 2014 (see Section 7.2), following the incubation of Zettice. XTREMLOGIC recently won the "concours région rhône-alpes" grant in November 2014 (40k).

- Tomofumi Yuki was hired as an Inria researcher and became a permanent member of Compsys.

- The 1988 "Array Expansion" seminal paper of Paul Feautrier has been selected for the 25th Anniversary Volume of the ACM International Conference on Supercomputing (ICS) together with 34 other papers selected from the 1800 papers published from 1987 to 2011. A short "reminescence" paper [13] was written for the occasion.

- The team was evaluated in Nov. 2014 by the HCERES (new name of AERES), as part of the LIP lab evaluation. The report has not been received yet.

From a scientific point of view, the shift, in Compsys III, towards the analysis of parallel programs and the extensions of the polyhedral model, both in terms of techniques and applications, is continuing, see the section "New Results", in particular:

- The design (by Christophe Alias and Alexandru Plesco) of a HLS compiler technology (see Section 6.2), patented by Inria [12] and transferred to XTREMLOGIC under an Inria licence (see Section 5.5).

- Two new static analyses: a more precise array bound check analysis [9] (see Section 6.3) and a more scalable termination algorithm for C programs (see Section 6.4).

- A novel equivalence-checking algorithm [7] modulo associativity/commutativity, which is a first step towards semantic program transformations (see Section 6.5).

- A groundbreaking introduction of polyhedral techniques for the analysis of parallel programs, in particular X10 (see [29] and [6]) and OpenStream (see Section 6.6).

- A seminal paper [5] introducing polynomial techniques in program analysis and compilation (see Section 6.7).

- Innovative contributions on parametric tiling [8], [3], [4] as extensions of the polyhedral model (see Sections 6.8 and 6.9).

CONVECS Project-Team (section vide)

CORIDA Team

6.1. Highlights of the Year

The CORIDA team organized two scientific meetings in 2014.

The first workshop, "Observers for finite and infinite dimensional systems" in April 2014, gathered people working in the field of control theory for finite and infinite dimensional systems.

Ten speakers from France, India, Portugal and Germany were invited for the second workshop, "Workshop in Mathematical Fluid Dynamics", in November 2014.

CQFD Project-Team

6.1. Highlights of the Year

Creation of the Associate Team Inria: CDSS (2014-2016) with the University of Sao Paulo, Brasil.

CRYPT Team

4.1. Highlights of the Year

The team published [20] improved single-key attacks on reduced-round AES: AES is currently the most widespread block cipher standard, it is implemented in Intel processors.

The team also showed [18] how to speed-up a well-known public-key cryptanalysis technique: finding small roots of univariate polynomial congruences. This technique is used to break special cases of the RSA cryptosystem.

Phong Nguyen was Program co-Chair of the 33rd IACR Eurocrypt Conference (EUROCRYPT 2014) [22].

CTRL-A Exploratory Action

6.1. Highlights of the Year

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 member, as well as workshops chair, of the 12th IEEE International Conference on Autonomic Computing, ICAC 2015 (http://icac2015.imag.fr/), and PC co-chair of the 3rd IEEE International Conference on Cloud and Autonomic Computing, CAC 2015 (http://autonomic-conference.org/), the two major conferences on the topic.

- control: Eric Rutten is organizer of a special session on discrete control for computing at the 12th IFAC - IEEE International Workshop on Discrete Event Systems, WODES 2014 (http://wodes2014. lurpa.ens-cachan.fr/), the main conference specialized in Discrete Event Systems, ; 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).

DAHU Project-Team

6.1. Highlights of the Year

Victor Vianu was elected member of Academia Europaea.

BEST PAPER AWARD :

[21] **Joint 25th International Conference on Rewriting Techniques and Applications and 12th International Conference on Typed Lambda Calculi and Applications**. S. SCHMITZ.

DANTE Team

6.1. Highlights of the Year

6.1.1. The Internet of Things: A new equipments of excellence

Inaugurated last autumn, the very large scale IoT-LAB platform (https://www.iot-lab.info) is strengthening the capabilities of the FIT equipment of excellence dedicated to the Internet of Things. Offering a unique wide-ranging collection of equipment, these laboratories are available to both researchers and commercial companies alike.

IoT-LAB is a large-scale experimental platform for communicating objects and networks of sensors. It enables the rapid deployment of experiments and the collection of large amounts of data. It includes over 2700 sensor nodes, distributed over six sites in France, offering a wide range of different processor architectures and radio components. IoT-LAB is available for use on line. It is already used by over 300 users in forty countries, including around ten commercial companies. As of the end of October 2014, some 10 000 experiments had already been carried out.

6.1.2. Graph-based signal processing

Our first results towards the definition of a digital framework for signal processing on graphs constitutes an important outcome of DANTE's activity in 2014. Our participation to this emerging discipline was marked with several scientific recognitions: publication in the main DSP conference [14], involvement in the first ANR project focusing on this theme and retained for funding (2015-2019), we are in charge of the organisation of a Special Session dedicated to "Methodologies for signal processing on graphs" at Eusipco conference (2015).

6.1.3. Complex contagion process

Diffusion of innovation can be interpreted as a social spreading phenomena governed by the impact of media and social interactions. Although these mechanisms have been identified by quantitative theories, their role and relative importance are not entirely understood, since empirical verification has so far been hindered by the lack of appropriate data. Here we analyse a dataset recording the spreading dynamics of the world's largest Voice over Internet Protocol service to empirically support the assumptions behind models of social contagion. We show that the rate of spontaneous service adoption is constant, the probability of adoption via social influence is linearly proportional to the fraction of adopting neighbors, and the rate of service termination is time-invariant and independent of the behavior of peers. By implementing the detected diffusion mechanisms into a dynamical agent-based model, we are able to emulate the adoption dynamics of the service in several countries worldwide. This approach enables us to make medium-term predictions of service adoption and disclose dependencies between the dynamics of innovation spreading and the socioeconomic development of a country. This work was recently published in the Journal of the Royal Society Interface.

DEDUCTEAM Exploratory Action

6.1. Highlights of the Year

In the framework of the *BWare* project, Pierre Halmagrand, David Delahaye, Damien Doligez, and Olivier Hermant designed a new version of the *B* set theory using deduction modulo, in order to automatically verify a large part of the proof obligations of the benchmark of *BWare*, which consists of proof obligations coming from the modeling of industrial applications (about 13,000 proof obligations). Using this *B* set theory modulo with *Zenon Modulo*, as well as some other extensions of *Zenon*, such as typed proof search and arithmetic (implemented by Guillaume Bury), we are able to automatically verify more than 95% of the proof obligations of *BWare*, while the regular version of *Zenon* is only able to prove less than 1% of these proof obligations. This is a real breakthrough for the *BWare* project, but also for automated deduction in general, as it tends to show that deduction modulo is the way to go when reasoning modulo theories.

DEFI Project-Team (section vide)

DEMAR Project-Team (section vide)

DIANA Team

5.1. Highlights of the Year

Arnaud Legout and Thierry Parmentelat designed and realized the very first Inria Mooc hosted on the FUN platform. This Mooc is devoted to the study of the Python language, and targets undergrandudate students. The objective of the course is to give students a thorough understanding of the internal mechanisms of language, and lead them to small and realistic applications. This Mooc was a big success: 9166 persons registered to the course, out of them five hundred followed the whole course and more than a hundred finished the project. For more details on this Mooc see https://www.france-universite-numerique-mooc.fr/courses/inria/41001/Trimestre_4_2014/about.

DICE Team (section vide)

DIONYSOS Project-Team

5.1. Highlights of the Year

Pierre L'Ecuyer received the Award of Merit from the Canadian Operational Research Society, 2014.

We had one best paper award in 2014 on a novel architecture for resilient networks (see 5.8).

BEST PAPER AWARD :

[50] **IEEE International Conference on Innovations for Community Services**. D. LEQUÉRÉ, C. BE-TOULE, G. THOUENON, Y. HADJADJ-AOUL, A. KSENTINI, R. CLAVIER.

DISCO Project-Team (section vide)

DIVERSE Project-Team

6.1. Highlights of the Year

"Globalizing Modeling Languages" appears in IEEE Computer Magazine. This paper synthesizes our vision of how domain-specific languages form the foundations of global software development. Its appearance in a highly visible venue is major milestone for the dissemination and impact of our work about the diversity of languages.

DiverSE extremely present at the SPLC conference. SPLC is the main international conference for software product line engineering. In 2014, the DiverSE team had a very strong presence at this conference, presenting novel scientific contributions, results of industrial collaborations, and demonstrations of latest software tools.

DOLPHIN Project-Team

6.1. Highlights of the Year

In [23], we have revisited the design and implementation of the Branch and Bound algorithm for solving on large scale distributed environments challenging permutation-based optimization problems such as Q3AP. The new approach includes original ways to efficiently deal with some crucial issues mainly, dynamic adaptive load balancing and fault tolerance. The approach allowed to solve to optimality for the first time a difficult Q3AP instance (Nug15) on the nation-wide Grid'5000 computational grid. The resolution was completed within less than 12 days using an average of 1,123 processing cores distributed over 6 Grid'5000 sites and peaked at 3,427.

DRACULA Project-Team

6.1. Highlights of the Year

- Marine Jacquier and Fabien Crauste (in collaboration with C.O. Soulage and H.A. Soul) published a paper ([18], see also § 6.7) in PLoS ONE 2014.

- Sotiris Prokopiou, Loic Barbarroux, Samuel Bernard, Olivier Gandrillon and Fabien Crauste (in collaboration with J. Mafille, Y. Leverrier, C. Arpin and J. Marvel) published a paper ([21], see also § 6.2) in Computation 2014.

- We organized a session "Deterministic and stochastic models in biology and medicine" at 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Madrid (Spain), 7 - 11 July 2014 http://www.aimsciences.org/conferences/2014/.

- Our project entitled "Prion and Alzheimer: mathematical modeling and experiments dealing with a dangerous liaison" has been granted by the French Association France Alzheimer, and has been selected with 3 other projects amongst 14 supported works to be part of a scientific popularizing broadcasting campaign through a short scientific cartoon http://www.francealzheimer.org/projets-soutenus-cette-ann%C3%A9e/lab-alz-comprendre-enjeux-recherche/964 and https://www.youtube.com/watch?v=X0mLf8IJhV4&list=PLCq-e7n2r6Wgo3kaseDHetNAPAG7y9B-d.

DREAM Project-Team (section vide)

DREAMPAL Team

5.1. Highlights of the Year

The papers [4] and [6] are published in journals (Software Testing Verification and Analisys, resp. Formal Aspects of Computing) that are among the best in their respective fields.

DYLISS Project-Team

6.1. Highlights of the Year

Four PhD theses were defended this year. They evidenced that ASP-technologies are now mature enough to perform data integration of large-scale bio-molecular datasets: classification of families of proteins [10], reconstruction of regulatory networks [13], reconstruction of metabolic network [11], and modelling of the discrete dynamics of a signalling or a regulatory network [12]. Importantly, symbolic classification technics have been adapted to exhibit relevant biological features: we used both formal concept analysis and semantic-based analysis for sequence and network analysis.

DYOGENE Project-Team

6.1. Highlights of the Year

- F. Baccelli received 2014 IEEE Communications Society Stephen O. Rice Prize in the Field of Communications Theory:

  http://www.comsoc.org/about/memberprograms/comsoc-awards/rice.

- F. Baccelli received 2014 IEEE Communications Society Leonard G. Abraham Prize in the Field of Communications Systems:

  http://www.comsoc.org/about/memberprograms/comsoc-awards/abraham.

- F. Baccelli received ACM Sigmetrics Achievement Award 2014:

  http://www.sigmetrics.org/achievementaward-2014.shtml.

- F. Simatos received 2014 ACM SIGMETRICS Rising Star Researcher Award:

  http://www.sigmetrics.org/risingstar-2014.shtml.

- P. Brémaud published a book "Fourier Analysis and Stochastic Processes". Series: Universitext. Springer, Sept. 2014 - 385 pages.

- PhD student C. Rovetta received best tool paper award at Valuetools 2014 for the paper [18].

E-MOTION Project-Team

5.1. Highlights of the Year

- C. Laugier, E. Mazer and K. Mekhnacha have been finalists for the Eurobotics Technology Award 2014. Title "Bayesian perception & Decision: from theory to industrial applications". March 2014.

- A. Nègre, L. Rummelhard, M. Perrollaz and C. Laugier had applied for a petenent "Procédé d'analyise d'une scene dybnamique, module d'analyse et programme d'ordinateur associés".

ECUADOR Project-Team (section vide)

ESTASYS Exploratory Action

6.1. Highlights of the Year

The Plasma statistical model checker has been made available to other scientists. ESTASYS has open a new branch on verifying the security of complex systems.

EXMO Project-Team

6.1. Highlights of the Year

- Our work on link key extraction and evaluation (§6.3.4) has been published at ECAI 2014.
- Jérôme Euzenat has been elected fellow of the European Coordination Committee for Artificial Intelligence (ECCAI).

FLOWERS Project-Team

6.1. Highlights of the Year

PY. Oudeyer and M. Lopes, together with J. Gottlieb (Univ. Columbia, NY) organized the first International Symposium on Neurocuriosity symposium on Information Seeking, Curiosity and Attention, pioneering a gathering of world experts on curiosity from developmental psychology, neuroscience, ethology and computational modelling (see https://openlab-flowers.inria.fr/t/first-interdisciplinary-symposium-on-information-seeking-curiosity-and-attention/21). This was achieved in the context of associated team Neurocuriosity with the cognitive neuroscience lab of J. Gottlieb at Univ. Columbia, NY, US. The first results investigating predictions of theoretical formal models of curiosity on human exploration were also published [25].

O. Mangin obtained the Best thesis poster from Bordeaux doctoral school of mathematics and computer science, for his PhD thesis "The Emergence of Multimodal Concepts: From Perceptual Motion Primitives to Grounded Acoustic Words" [24].

The team, in collaboration with Inaki Iturrate and Luis Montesano, published major results on calibration-free brain-computer interface methods, where incremental machine learning algorithms are used to remove the phase of calibration for an important family of use contexts [44] [45].

In october 2014, the team announced the release of a new version of the Poppy Project platform, dedicated in particular to the use of tools for creating and programming interactive robots in Education and Art. This platform, which is a result of research on the role of morphology in skill acquisition within ERC project Explorers, was selected as finalist for the Global Fab Awards 2014 (https://www.fab10.org/en/awards) which select the best worldwide projects in the Makers ecosystem. It was also presented in major international press and media (https://www.poppy-project.org/in-the-press/), in multiple hackatons and demos, in particular at the major international conference LeWeb (https://www.poppy-project.org/social-life/, and its video on the web was seen 125k times. Poppy Project was presented at Elysée, during a French Tech event, to François Hollande (http://www.inria.fr/centre/bordeaux/actualites/poppy-le-robot-humanoide-a-l-elysee), and in Bordeaux to Axelle Lemaire. Web site: http://www.poppy-project.org

The Flowers team made major achievements in diffusing science and technology towards the general public. The team developed the IniRobot pedagogical kit, for the discovery of computer science and robotics in primary schools. The kit was first developed and evaluated in schools, in collaboration with a group of teachers, and then began to be largely disseminated and used in september 2014 to schools in Talence, Bordeaux, Lormont, and Lille. A dedicated web site has been created, allowing all users and contributors to share their experiences with the kit: https://dm1r.inria.fr/c/kits-pedagogiques/inirobot. PY. Oudeyer was invited to give a TedX talk (https://www.youtube.com/watch?v=AP8i435ztwE, video viewed by more than 9000 people), and was interviewed and invited to talk about our research on major media channels (e.g. Le Monde, Les Echos, France Inter, see http://www.pyoudeyer.com/press/).

FLUMINANCE Project-Team

6.1. Highlights of the Year

6.1.1. Stochastic fluid flow dynamics under uncertainty

We have proposed the basis of a formalism allowing to built large scale stochastic representation of fluid flows dynamics [17]. This formalism relies on a location uncertainty principle which separates the flow in terms of a resolved large scale component and a highly oscillating random component. The dynamics is built in a similar way as in the deterministic case through a stochastic representation of the Reynolds transport theorem. This principle paves a new way for the construction of subgrid models from the uncertainties we have on the flow. The associated subgrid tensor provides a clear interaction between small scale data and large scale resolved quantities. This characteristic opens new directions for the devising of methods for the nulmerical simulation of large scale components of the flow. It allows also deriving large-scale models that takes into account explicitly the inherent errors to a particular geophysical dynamics representation.

FOCUS Project-Team

6.1. Highlights of the Year

Valeria Vignudelli has received the AILA (Associazione Italiana di Logica e sue Applicazioni) award for her 2014 master thesis.

FUN Project-Team

5.1. Highlights of the Year

- Opening of the 256 M3 sensor nodes of the Lille's FIT IoT Lab platform.

- We have designed a novel single-based localization method, UNS, for accurate localization of mobile devices that only needs a small aperture array unlike all previous works. UNS is currently under patenting.

- We have provided a set of recognized contributions in the area of Smart Cities, re-thinking their architecture and break vertical silos between every network and application.

GALAAD2 Team (section vide)

GALEN Project-Team

6.1. Highlights of the Year

- Handbook of Biomedical Imaging: Methodologies and Clinical Research [38] - co-edited from Nikos Paragios, James Duncan and Nicholas Ayache - has been published from Springer Publishing house.
- Nikos Paragios was admitted as a senior fellow at the Insitut Universitaire de France and has been awarded an IBM Faculty award. He has also been one of the plenary invited lecturers at the IARP International Conference in Pattern Recognition (ICPR'2015, Stockholm).

BEST PAPER AWARD :

[26] **Sparsity Techniques in Medical Imaging (STMI)**. M. MISYRLIS, A. KONOVA, M. BLASCHKO, J. HONORIO, N. ALIA-KLEIN, R. GOLDSTEIN, D. SAMARAS.

GALLIUM Project-Team (section vide)

GAMMA3 Project-Team (section vide)

GANG Project-Team

5.1. Highlights of the Year

Pierre Fraigniaud has received the Prize for Innovation in Distributed Computing 2014.

GCG Team

6.1. Highlights of the Year

Graduate Research Award of the OSU department in 2015 for Venmugil Elango (co-advised by Fabrice Rastello)

GECO Project-Team

6.1. Highlights of the Year

We organized a thematic trimester on "Geometry, analysis and dynamics on sub-Riemannian manifolds" at the Institut Henri Poincaré (IHP), including 4 workshops, 4 research courses, 8 thematic days, several seminars. We also organized an associated school at CIRM with 4 introductory courses. The web pages of the events are:

http://www.cmap.polytechnique.fr/subriemannian/
http://www.cmap.polytechnique.fr/subriemannian/cirm/

GENSCALE Project-Team

6.1. Highlights of the Year

discoSnp published in NAR. The publication presents a wide range of discoSnp applications that highlight the advantages and the drawbacks of predicting SNPs when no reference genomes are available. The publication witnesses the enthusiasm of users regarding both reference-free methods and the quality of the method. [20]

GEOMETRICA Project-Team

6.1. Highlights of the Year

[10] was elected among the notable articles of 2013 by ACM and Computing Reviews (see http://computingreviews.com/recommend/bestof/notableitems_2013.cfm).

GEOSTAT Project-Team

6.1. Highlights of the Year

Paper **Spanning the Scales of Granular Materials through Microscopic Force Imaging** by N. Brodu *et al.* accepted in **Nature Communications** (will appear in 2015).

BEST PAPER AWARD :

[36] **IEEE TENSYMP 2014**. B. XU, S. BINCZAK, S. JACQUIR, O. PONT, H. YAHIA.

GRACE Project-Team

6.1. Highlights of the Year

- F. Morain and A. Guillevic (with their co-authors R. Barbulescu and P. Gaudry) broke the discrete logarithm world record for finite fields of the form $GF(p^2)$ with a prime p of 80 decimal digits. The new techniques form the preprint [31].

- D. Augot and M. Finiasz received the best paper award at FSE 2014 [17]. FSE is the most important conference devoted to symmetric cryptography. Grace contribution is to propose a mathematical construction which enables direct construction of so-called diffusion layers in block ciphers.

- A. Zeh, former Grace PhD student, received the special Prize of the Université Franco-Allemande (UFA) Jury 2014 at the French Ambassy in Berlin, on November 21st.

BEST PAPER AWARD :

[17] **21st International Workshop on Fast Software Encryption, FSE 2014**. D. AUGOT, M. FINIASZ.

GRAPHIK Project-Team

6.1. Highlights of the Year

- *Michael Thomazo was awarded the AFIA Prize 2014 (French Association for Artificial Intelligence) for his PhD entitled "Conjunctive Query Answering Under Existential Rules - Decidability, Complexity, and Algorithms" defended in October 2013. He was also awarded the first accessit of Gilles Kahn Prize 2014 by the SIF (French Society for Computer Science) [14].*

- *Madalina Croitoru and Alain Gutierrez were awarded the Best Technical Paper of SGAI-2014 for "On Ontological Expressivity and Modelling Argumentation Schemes using COGUI", in collaboration with Wael Hamdan, Rady Khazem and Ghaida Rebdawi .*

- *Abdallah Arioua was awarded the Best Student Paper Award of SGAI-2014 for "Query Failure Explanation in Inconsistent Knowledge Bases: A Dialogical Approach" in collaboration with Nouredine Tamani, Madalina Croitoru and Patrice Buche .*

BEST PAPERS AWARDS :

[36] **AI'2014: Thirty-fourth SGAI International Conference on Artificial Intelligence**. W. HAMDAN, R. KHAZEM, G. REBDAWI, M. CROITORU, A. GUTIERREZ, P. BUCHE.

[28] **AI'2014: 34th SGAI International Conference on Innovative Techniques and Applications of Artificial Intelligence**. A. ARIOUA, N. TAMANI, M. CROITORU, P. BUCHE.

HEPHAISTOS Team

6.1. Highlights of the Year

Yves Papegay received a "Wolfram Innovator Award" in December 2014

HIEPACS Project-Team

6.1. Highlights of the Year

In the context of HPC-PME initiative, we started a collaboration with ALGO'TECH INFORMATIQUE and we have organised one of the first PhD-consultant action implemented by Xavier Lacoste led by Pierre Ramet. ALGO'TECH is one of the most innovative SMEs (small and medium sized enterprises) in the field of cabling embedded systems, and more broadly, automatic devices. The main target of the project is to validate the possibility to use the sparse linear solvers of our team in the area of electromagnetic simulation tools developed by ALGO'TECH. This collaboration will be developed next year in the context of the European project FORSTISSIMO. The principal objective of FORTISSIMO is to enable European manufacturing, particularly SMEs, to benefit from the efficiency and competitive advantage inherent in the use of simulation.

As a conclusion of the OPTIDIS project we organized the first International Workshop on Dislocation Dynamics Simulations that was devoted to the latest developments realized worldwide in the field of Discrete Dislocation Dynamics simulations. This international event held in December 10th to the 12th at "Maison de la Simulation" in Saclay, France and attracted 55 participants from many different countries including England, Germany, France, USA, ... The workshop gathered most of the active researchers working on dislocation dynamics from numerical simulations to experimentatios. Thanks to the success of this workshop, a second one will be scheduled in England during 2016.

HIPERCOM2 Team

6.1. Highlights of the Year

- Hipercom 2 took part to the Inria-Industry meeting focusing on Telecommunications organized by Inria at Rocquencourt in November 2014. We presented a demonstration of the OCARI wireless sensor network.

- Hipercom 2 organized an Inria-DGA day "Software Defined Network (SDN) & MANET" at Paris in October 2014.

HYBRID Project-Team

6.1. Highlights of the Year

- Paper [22] from Merwan Achibet, Maud Marchal, Ferran Argelaguet and Anatole Lécuyer received the "Best Paper Award" at IEEE Symposium on 3D User Interfaces 2014 (IEEE 3DUI'14).
- Paper [26] from Jean-Baptiste Barreau, Valérie Gouranton received the "Third Best Poster Award" at International Conference on Cultural Heritage 2014.

BEST PAPERS AWARDS :

[22] **IEEE Symposium on 3D User Interfaces**. M. ACHIBET, M. MARCHAL, F. ARGELAGUET SANZ, A. LÉCUYER.

HYCOMES Team

6.1. Highlights of the Year

The main advances in 2014 of the Hycomes team have been as follows:

Causality analysis of hybrid systems with ordinary differential equations (ODE) We have proposed a causality analysis, in the form of a simple type system, rejecting hybrid programs with algebraic circuits — see section 6.2 .

An index theory of DAE hybrid systems with differential algebraic equations (DAE) We have proposed a conservative extension of the notion of differentiation index to hybrid systems with differential algebraic equations — see section 6.3 .

I4S Project-Team

6.1. Highlights of the Year

The team organized the 7th European Workshop on SHM in Nantes in July 2014 (http://ewshm2014.com) .

IBIS Project-Team

5.1. Highlights of the Year

A paper based on the PhD thesis of Diana Stefan was accepted for *PLoS Computational Biology* this year [7].

IMAGINE Project-Team

6.1. Highlights of the Year

- Vector Graphics Complexes, an new structure for 2D illustration developed in collaboration with UBC, resulted into a publication at ACM SIGGRAPH [4]. This superset of multi-layers graphics and of planar maps, enable intuitive design and deformation of 2D illustrations thanks to the separation of geometry from topology.

- Our work on elastic implicit skinning, a collaboration with U. Toulouse, Victoria University, and Inria Bordeaux was accepted at ACM SIGGRAPH Asia [16]. Thanks to robust iso-surface tracking, this method captures dynamic skin siding effects and can be used with extreme bending angles.

IN-SITU Project-Team

6.1. Highlights of the Year

Wendy Mackay received the *ACM SIGCHI Lifetime Service Award*.

BEST PAPERS AWARDS :
[22] **CHI '14**. C. LIU, O. CHAPUIS, M. BEAUDOUIN-LAFON, É. LECOLINET, W. E. MACKAY.

INDES Project-Team (section vide)

INFINE Team

6.1. Highlights of the Year

- We proved a conjecture made in 2011 about the feasibility of non-trivial community detection just above a threshold below which it was known that only trivial detection could be done, see [13]. This was published in ACM STOC'14 and well-received, as the proof required the invention of new techniques to control the spectral properties of random matrices.

- The official opening of IoT-LAB of all sites through the "Workshop Internet Of Things/Equipex FIT IoT-LAB" held in Grenoble (on 6 and 6 november 2014), has been a major event for our team: it concludes several years of preparation of the IoT-LAB site located in Rocquencourt, currently managed by C. Adjih, E. Baccelli and I. Amdouni, which was itself opened the same month https://www.iot-lab.info/opening-of-the-paris-rocquencourt-site/.

IPSO Project-Team

5.1. Highlights of the Year

- E. Faou was plenary speaker at the CANUM, Congrès d'analyse numérique, France, June 2014
- E. Faou was invited to give two presentations in the Analysis and applied mathematics seminars, Cambridge, UK, February 2014.

KALIFFE Project-Team (section vide)

KerData Project-Team

6.1. Highlights of the Year

IEEE Cluster 2014.   The KerData Team had a leading role the organization of the IEEE Cluster 2014 conference, held in Madrid (22–26 September 2014): Gabriel Antoniu as PC Chair, Luc Bougé as Student Mentoring Program Chair, Alexandru Costan as Submissions Chair.

LAGADIC Project-Team (section vide)

LEAR Project-Team

6.1. Highlights of the Year

- Cordelia Schmid received the **Longuet-Higgins prize** for fundamental contributions in computer vision that have withstood the test of time, 2014.

- We participated to the **Trecvid 2014 Multimedia Event Detection** challenge. We ranked first on one of the four tracks (Ad-hoc training videos with 10 examples per class).

- We participated to the **THUMOS 2014 challenge**. We obtained top ranked results in the localization track of the Thumos 2014 Action Recognition Challenge. The goal of the challenge is to evaluate large-scale action recognition in natural settings.

LEMON Team

6.1. Highlights of the Year

Antoine ROUSSEAU and 5 co-authors released in 2014 the book *Brèves de Maths* [16]. This work (in french) selected more than 100 posts from the blog breves-de-maths.fr, in the framework of the international initiative "Mathematics of the Planet Earth". In this book (see cover 5), no complicated numbers, no weird equation, but short and clear sentences together with nice drawings to illustrate everyday life topics on our planet with the beauty of mathematics.

Figure 5. Brèves de Maths. Ed. Nouveau Monde, 2014

LFANT Project-Team

5.1. Highlights of the Year

Aurel Page has defended his PhD thesis on *Méthodes explicites pour les groupes arithmétiques* [12] in July 2014. Nicolas Mascot has defended his PhD thesis on *Computing modular Galois representations* [11], in July 2014.

LIFEWARE Team (section vide)

LINKMEDIA Project-Team

6.1. Highlights of the Year

BEST PAPER AWARD :

[21] **European Symposium on Research in Computer Security**. R. BALU, T. FURON, S. GAMBS.

LINKS Team

5.1. Highlights of the Year

In the objective Querying Heterogeneous Linked Data, Slawomir Staworko and Iovka Boneva have developed new ways to define schema for Graph Database and RDF [19]. This work has been influencing a group work of W3C on defining a schema for the DF format. This work is a continuation of [3] (by Iovka Boneva, Radu Ciucanu and Slawomir Staworko) developing a new schema for unordered trees over XML. Due to these works, Boneva is now a member of the Data Shapes Working Group which mission is to produce a language for defining structural constraints on RDF graphs. http://www.w3.org/2014/data-shapes/charter

In the objective Managing Dynamic Linked Data, the main break through is the development of QuixPath that now covers 100 per cent of the XPathMark, a W3C benchmark for the language Xpath (querying XML trees). In particular, it includes aggregation operators, joins and arithmetics operations. The core of QuixPath is based on techniques presented in [6] (by Tom Sebastian, Denis Debardieux and Joachim Niehren).

In the objective Linking Data Graphs, different methods have been developed to learn queries over graph. More precisely, the queries learned are conjunctive queries with joins. These techniques have been presented in [13] and demonstrated in [4] at the conference VLDB.

M3DISIM Team

6.1. Highlights of the Year

- Radomir Chabiniok recruited in starting research position (start Febr 2015);
- PhD Defense of Annabelle Collin;
- "Usine Nouvelle" article.

MADYNES Project-Team

6.1. Highlights of the Year

The following points of 2014 deserves to be highlighted:

- One new permanent member joined the MADYNES team: Jérôme François as Inria researcher.
- An IBM Faculty Award has been received by a team member (Rémi Badonnel, TELECOM Nancy) for his work on security and cloud computing.

BEST PAPER AWARD :

[21] **8th IFIP WG 6.6 International Conference on Autonomous Infrastructure, Management, and Security, AIMS 2014**. A. MAYZAUD, A. SEHGAL, R. BADONNEL, I. CHRISMENT, J. SCHÖNWÄLDER.

MAESTRO Project-Team

6.1. Highlights of the Year

E. Altman has received the "Isaacs' Award" granted by the International Society on Dynamic Games in recognition for his research on dynamic game theory.

M. El Chamie got the Best Session Presentation Award at the IEEE American Control Conference ACC 2014 for the paper "Newton's method for constrained norm minimization and its application to weighted graph problems," co-authored with G. Neglia.

THANES is a new French-Brazilian joint-team between MAESTRO and researchers from Univ. Federal do Rio de Janeiro (Brazil) and Carneggie Mellon Univ. (USA). The team investigates network science problems with a particular focus on Online Social Networks.

BEST PAPERS AWARDS :

[43] **6th IEEE INFOCOM International Workshop on Network Science for Communication Networks (NetSciCom)**. K. AVRACHENKOV, P. BASU, G. NEGLIA, B. RIBEIRO, D. TOWSLEY.

[70] **4th IEEE Online Conference on Green Communications (GreenComm)**. C. ROTTONDI, G. NEGLIA, G. VERTICALE.

MAGIQUE-3D Project-Team (section vide)

MAGNET Team

6.1. Highlights of the Year

We developed a new framework for high order learning [4].

We have illustrated the usefulness of automatically annotated examples in complex learning supervised by few training examples [2], [1].

We propose a new algorithm for semi-supervised spectral clustering and apply it to the NLP task of noun phrase coreference resolution [6].

MAGNOME Project-Team

6.1. Highlights of the Year

In collaboration with colleagues from the Institut du Vigne et du Vin (ISVV), Bordeaux and the Universidade Nova de Lisboa, Lisbon we used a population genomics approach to investigate the global phylogeography and domestication fingerprints of winemaking yeasts, using a collection of isolates obtained from fermented beverages and from natural environments on five continents. These results appeared in *Nature Communications* [11].

MAGRIT Project-Team

6.1. Highlights of the Year

We were invited to present our work on *Impact of Soft Tissue Heterogeneity on Augmented Reality for Liver Surgery* in the TVCG Special Session at SIGGRAPH Asia 2014.

MAIA Project-Team

6.1. Highlights of the Year

- Two Research Fellow have been recruited with a focus on Service Robotics: Serena Ivaldi (CR2) and Francis Colas (CR1).

- The paper entitled : Exploiting Separability in Multiagent Planning with Continuous-State MDPs Jilles Dibangoye, Christopher Amato, Olivier Buffet, François Charpillet won the best paper award at AAMAS'2014, the international conference on autonomous agents and multi-agents.

- Jilles Dibangoye got an Assistant Professor position at INSA Lyon.

BEST PAPER AWARD :

[12] **13th International Conference on Autonomous Agents and Multiagent Systems**. J. S. DIBANGOYE, C. AMATO, O. BUFFET, F. CHARPILLET.

MAMBA Team

6.1. Highlights of the Year

Benoît Perthame was invited as plenary speaker for the International Congress of Mathematicians ICM 2014 (Seoul, http://www.icm2014.org), that attracted more than 5000 participants. This is the first time that a mathematician working in mathematics applied to biology was invited at ICM, which is the most prestigious conference for mathematicians of all fields. This represents a consecration both for Benoît Perthame's work and for the MAMBA team, and more generally for the whole domain of mathematics applied to biology.

Marie Doumic was a plenary speaker at the ECMTB 2014 (Göteborg, http://ecmtb2014.org/ 600 participants).

Dirk Drasdo was invited speaker at the Systems Biology of Human Diseases conference (Harvard University, http://www.csb2.org/events/sbhd-2014).

Five articles are noteworthy in terms of bibliometry:

• (*Impact factor 11.2*) F. SCHLIESS, S. HOEHME, S. HENKEL, A. GHALLAB, D. DRIESCH, J. BÖTTGER, R. GUTHKE, M. PFAFF, J. HENGSTLER, R. GEBHARDT, D. HÄUSSINGER, D. DRASDO, S. ZELLMER. Integrated metabolic spatial-temporal model for the prediction of ammonia detoxification during liver damage and regeneration, *Hepatology*, Dec. 2014, vol. 60, no 6, pp. 2040-2051, https://hal.inria.fr/hal-01110646 [17]

• (*Impact factor 10.4*) D. DRASDO, S. HOEHME, J. G. HENGSTLER. How predictive quantitative modeling of tissue organization can inform liver disease pathogenesis, *Journal of Hepatology*, Oct. 2014, vol. 61, no 4, pp. 951-956 [DOI : 10.1016/J.JHEP.2014.06.013], https://hal.inria.fr/hal-01110644 [7]

• (*Impact factor 10.7*) S.R.K. VEDULA, G. PEYRET, I. CHEDDADI, T. CHEN, A. BRUGUÉS, H. HIRATA, H. LOPEZ-MENENDEZ, Y. TOYAMA, L. NEVES DE ALMEIDA, X. TREPAT, C.T. LIM, B. LADOUX. Mechanics of epithelial closure over non-adherent environments, *Nature Communications*, Jan. 2015, vol. 6, art. number 6111[DOI : 10.1038/ncomms7111], http://www.nature.com/ncomms/2015/150122/ncomms7111/abs/ncomms7111.html (open access)

• (*Impact factor 7.5*) L. ROBERT, M. HOFFMANN, N. KRELL, S. AYMERICH, J. ROBERT, M. DOUMIC. Division in Escherichia coli is triggered by a size-sensing rather than a timing mechanism, in "BMC Biology", 2014, vol. 12, no 1, 17 p. [DOI : 10.1186/1741-7007-12-17], https://hal.inria.fr/hal-00981312 [16]

• (*Impact factor 9.3*) R. H. CHISHOLM, T. LORENZI, A. LORZ, A. K. LARSEN, L. ALMEIDA, A. ES-CARGUEIL, J. CLAIRAMBAULT. Emergence of drug tolerance in cancer cell populations: an evolutionary outcome of selection, nongenetic instability and stress-induced adaptation, *Cancer Research* (Mathematical oncology), 10p.+suppl. mat., in press, Jan. 2015, https://hal.archives-ouvertes.fr/hal-01111271 [33]

MANAO Project-Team

5.1. Highlights of the Year

We are still developping our expertise in fitting techniques. As an illustration, we have solved of a long-standing problem in fluid capture: the non-invasive three-dimensional digitization of dynamic gas flows *including their three-dimensional velocity fields* [17] (cf. Figure 8). We solve the three-dimensional flow tracking problem by fitting a full 3D Navier-Stokes simulation to the acquired data. To our knowledge, this is a world-first in this area that considerably improves the results by incorporating high-level prior knowledge into the estimate. The resulting mathematical framework can be generalized easily and lends itself to editing operations. The technique has applications, e.g., in aerospace engineering. We are exploring the possibilities with ONERA, the French space agency. In fact, parts of the developed techniques have been validated by them and are now being installed in a wind tunnel facility for real-world tests.
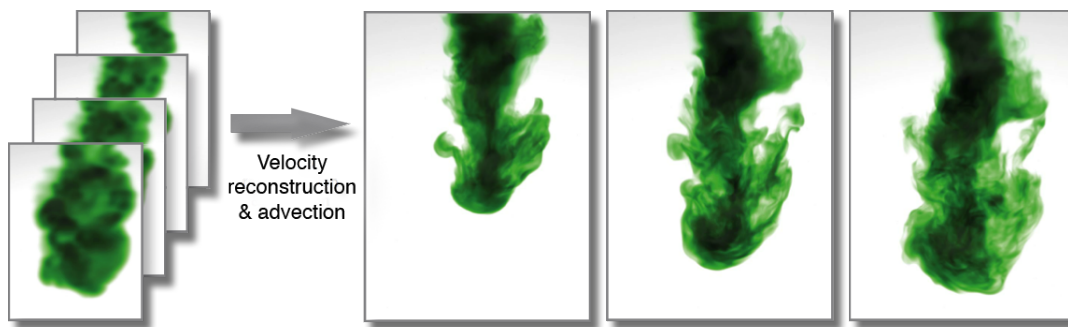
Figure 8. Low-resolution captures obtained by tomographic scanning (left) are used as inputs to our method which estimates physically plausible dense velocity fields. Such velocity fields fully determine the fluid state and can be applied in a variety of applications including fluid super-resolution (right) allowing capture to be integrated into pipelines for visual effects simulation.

This year, the collaboration between Optics and Computer Graphics has grown to a now long-term project, under the initiative of the MANAO team. First, from an institutional point of view, a framework agreement has been signed the 10th of July 2014 between the IOGS and Inria. This is an important and institutional recognition of the potential trans-disciplinary impacts of our work. Second, we have begun to set-up the COEL experimentation facility inside the LP2N laboratory. It has been made possible thanks to the support of the "Région Aquitaine" and upcoming supports from l'"Initiative d'excellence de l'université de Bordeaux". With this trans-disciplinary experimentation facility – rather unique in Europe – we can now put into practice a long-term vision of the researches that we want to achieve.

In term of visibility, we managed to published our first paper in the Optics scientific community [15], highlighting our trans-disciplinary research. We have also been part of the final and transnational exhibition of the V-Must.net network of excellence: Keys2Rome - http://keys2rome.eu. It was launched simultaneously in Rome, Sarajevo, Amsterdam and Alexandria on September 23, 2014. The exhibition uses immersive technology to present and connect these regional cultures within the Roman Empire, highlighting their diversity and commonality over centuries of Roman rule. Our spatial augmented reality solution [21] was included in this event.

MARELLE Project-Team

6.1. Highlights of the Year

In June 2014, Yves Bertot received the ACM Software System award, as one of the main contributors to the Coq System, along with Gérard Huet, Thierry Coquand, Christine Paulin-Mohring, Bruno Barras, Jean-Christophe Filliâtre, Hugo Herbelin, Chet. Murthy, and Pierre Castéran.

MASAIE Project-Team

5.1. Highlights of the Year

The estimation of sequestered parasite population has been a challenge for the biologist and modeler, with many authors having studied this problem. The difficulty is that the infected erythrocyte leaves the circulating peripheral blood and binds to the endothelium in the microvasculature of various organs. A measurement of Plasmodium falciparum parasitaemia taken from a blood smear therefore samples young parasites only and there is no clinical methods to measure the sequestered parasites. We have developed a simple tool to estimate the sequestered parasites and hence the total parasite burden for *Plasmodium falciparum* malaria patients. We have also given a method to estimate a crucial parameter in the model of infection. This parameter β can be thought as the "transmission/invading" factor between merozoites and erythrocytes. This work [9] has been published in "Mathematical Biosciences and Engineering".

MATHERIALS Team (section vide)

MATHRISK Project-Team

6.1. Highlights of the Year

B. Jourdain and A. Sulem : Guest editors of the special issue "Systemic Risk" of *Statistics and Risk Modeling*, 2014. [27]

The research project "Stochastic Control of Systemic Risk" has been awarded by the scientific council and Professional Fellows of Institut Europlace de Finance (EIF) and Labex Louis Bachelier (December 2014).

Roxana Dumitrescu, PhD student, received the price for collaborative actions during her PhD studies, delivered by Fondation des Sciences Mathématiques de Paris and CASDEN (November 2014).

Pierre Blanc, PhD student, has got the award of "Rising star of quantitative finance" for his talk on a price impact models with an exogeneous (Hawkes) flow of orders [29]. This prize was given by the Global Derivatives conference (Amsterdam, 12-16 May) to indicate the best work among PhD students.

MAVERICK Project-Team

5.1. Highlights of the Year

The impacting PhD work [3] of Eric Heitz on *appearance filtering* (see section 5.5.1) has received a very good reception in both academic and industrial world, including several "best paper" prizes in 2013 and 2014, invitation to participate to the Siggraph Course on Photorealistic Rendering [13], and statements of importance and/or integration by reference peoples and CG companies.

BEST PAPER AWARD :

[] **Computer Graphics Forum**. E. HEITZ, E. D'EON.

Maxplus Project-Team

6.1. Highlights of the Year

Nous avons donné un contre exemple inattendu à l'analogue continu de la conjecture de Hirsch, proposé par Deza, Terlaky et Zinchenko, voir Section 6.4.4 .

English version

We gave a somehow unexpected counter example to the continuous analogue of the Hirsch conjecture proposed by Deza, Terlaky and Zinchenko, see Section 6.4.4 .

MC2 Team

6.1. Highlights of the Year

- **Models for gliomas**
  Glioblastoma multiforme (GBM) causes significant neurological morbidity and short survival times. Brain invasion by GBM is associated with poor prognosis. Recent clinical trials of bevacizumab in newly-diagnosed GBM found no beneficial effects on overall survival times; however, the baseline health-related quality of life and performance status were maintained longer in the bevacizumab group and the glucocorticoid requirement was lower. In a recent work in collaboration with UAB, we have constructed a clinical-scale model of GBM whose predictions uncover a new pattern of recurrence in 11/70 bevacizumab-treated patients. The findings support an exception to the Folkman hypothesis: GBM grows in the absence of angiogenesis by a cycle of proliferation and brain invasion that expands necrosis. Furthermore, necrosis is positively correlated with brain invasion in 26 newly-diagnosed GBM. The unintuitive results explain the unusual clinical effects of bevacizumab and suggest new hypotheses on the dynamic clinical effects of migration by active transport, a mechanism of hypoxia-driven brain invasion.

- **Electroporation modeling** (M. Leguebe, C. Poignard)
  Based on the new discovery of the team of Vectorolgy and anti-cancerous therapies on the membrane lipid oxidation during the pulse delivery, we have provided a model of cell permeabilization that makes it possible to explain the process of electroporation : pore formation during the pulse and surface diffusion of altered lipids after the pulse. Our model explains the long-term effect of electroporation (the permeable state of the membrane lasts a few minutes after the pulse delivery). A 3D-code in C++ has been implemented during the PhD thesis of M. Leguèbe. The team MC2 is now part of the European Lab EBAM on electroporation modeling. An international workshop on Electroporation and Biophysical Therapies was held in Bordeaux the 15th and 16th December.

- Simulation of **multiphysic fluid-structure impacts in 3D**. See http://www.math.u-bordeaux1.fr/ adebrauer/ for astinishing videos.

MCTAO Project-Team (section vide)

MEPHYSTO Team

6.1. Highlights of the Year

A. Gloria, S. Neukamm, and F. Otto published their recent contribution [17] on quantitative homogenization in Inventiones Mathematicae.

As a plenary speaker of the World Congress of Computational Mechanics in Barcelone in July 2014, P. Le Tallec (Ecole polytechnique) presented our joint results [15], [25].

MESCAL Project-Team (section vide)

MEXICO Project-Team

6.1. Highlights of the Year

6.1.1. Active Diagnosis for Probabilistic Systems

Diagnosis fits well with probabilistic systems since it is natural to model the uncertainty about the behaviour of a partially observed system by distributions. We had previously revisited the active diagnosis (which aims at controlling the system to make it diagnosable) in discrete event systems designing optimal decision and synthesis procedures [7]. This year, we have considered active diagnosis for probabilistic discrete event systems, obtaining again optimal procedures [26]. Furthermore we have refined the notion of active diagnosis by introducing the *safe active diagnosis* which ensures that after the control is applied, there is a positive probability that a fault never occurs. Interestingly this problem is undecidable but for finite memory controller we have shown that the problem becomes again decidable and we have designed optimal decision and synthesis procedures. Our approach has raised an issue that has not be observed by previous researchers: while in discrete event system, most variants of diagnosis are in fact equivalent, this is no more the case for probabilistic systems. So in [26], we have undertaken the task of classifying the different versions obtaining a complete landscape of the notions both in terms of relations and complexity. Furthermore we have proposed a new notion of diagnosis, the *prediagnosis* that combines the advantages of diagnosis and prediction.

6.1.2. Weighted automata and weighted logics

Weighted automata are a conservative quantitative extension of finite automata that enjoys applications, e.g., in language processing and speech recognition. Their expressive power, however, appears to be limited, especially when they are applied to more general structures than words, such as graphs. To address this drawback, we have introduced weighted pebble walking automata, which allow to navigate freely in the graph and may use pebbles to mark some positions.

In [20], we have shown with examples from natural language modeling and quantitative model-checking that weighted expressions and automata with pebbles are more expressive and allow much more natural and intuitive specifications than classical ones. We have extended Kleene-Schützenberger theorem showing that weighted expressions and automata with pebbles have the same expressive power. We focussed on an efficient translation from expressions to automata. We also proved that the evaluation problem for weighted automata can be done very efficiently if the number of reusable pebbles is low.

In [18], we have studied the expressive power of these automata on words. We have proved that two-way pebble weighted automata, one-way pebble weighted automata, and our weighted logic with transitive closure are expressively equivalent. We also gave new logical characterizations of standard recognizable series.

In [30], we addressed the more general case of graphs such as nested words, trees, pictures, Mazurkiewicz traces, ... We established that weighted pebble walking automata have the same expressive power as weighted first order logic with transitive closure logic, lifting a similar result by Engelfriet and Hoogeboom from the Boolean case to a quantitative setting.

6.1.3. Verification of concurrent recursive programs

Distributed systems form a crucially important but particularly challenging domain. Designing correct distributed systems is demanding, and verifying its correctness is even more so. The main cause of difficulty here is concurrency and interaction (or communication) between various distributed components. Hence it is important to provide a framework that makes easy the design of systems as well as their analysis. There are two schools of thought on reasoning about distributed systems: one following the interleaving based semantics, and one following the visual partial-order/graph based semantics. In [23], we compare these two approaches and argue in favour of the latter. An introductory treatment of the split-width technique is also provided.

In [34], we develop a general technique based on split-width for the verification of networks of multi-threaded recursive programs communicating via reliable FIFO channels. We extend the approach of [6] to this setting. Split-width offers an intuitive visual technique to decompose our behaviour graphs such as MSCs and nested words. The decomposition is mainly a divide-and-conquer technique which naturally results in a tree decomposition. Every behaviour can now be interpreted over its decomposition tree. Properties over the behaviour naturally transfer into properties over the decomposition tree. This allows us to use tree-automata techniques to obtain decision procedures for a range of problems such as reachability, model checking against logical formalisms etc. In this way, we obtain simple, uniform and optimal decision procedures for various verification problems parametrised by split-width. Furthermore, the simple visual mechanism of split-width is as powerful as yardstick graph measures such as tree-width or clique-width. Hence it captures any class of distributed behaviours with a decidable MSO theory.

Multi-threaded recursive programs communicating via channels are turing powerful, hence their verification has focussed on under-approximation techniques. Any error detected in the under-approximation implies an error in the system. However the successful verification of the under-approximation is not as useful if the system exhibits unverified behaviours. In [24], we study controllers that observe/restrict the system so that it stays within the verified under-approximation. We identify some important properties that a good controller should satisfy. We consider an extensive under-approximation class, construct a distributed controller with the desired properties and also establish the decidability of verification problems for this class.

6.1.4. Regulation in Systems Biology

6.1.4.1. Rare events in Signalling Cascades

The visit in 2013 of Professor Monika Heiner from Cottbus University has led to a fruitful collaboration related to statistical model checking of rare events in signalling cascades (a regulatory biological system) [25]. This work has received one of the five top paper awards of the conference. In addition, we have improved the statistical methods used in our tool Cosmos.

6.1.4.2. Characterization of Reachable Attractors Using Petri Net Unfoldings

Attractors of network dynamics represent the long-term behaviours of the modelled system. Their characterization is therefore crucial for understanding the response and differentiation capabilities of a dynamical biological system. In the scope of qualitative models of interaction networks, the computation of attractors reachable from a given state of the network faces combinatorial issues due to the state space explosion.

In [33], we have presented a new algorithm that exploits the concurrency between transitions of parallel acting components in order to reduce the search space. The algorithm relies on Petri net unfoldings that can be used to compute a compact representation of the dynamics. We have illustrated the applicability of the algorithm with Petri net models of cell signalling and regulation networks, boolean and multi-valued. The proposed approach aims at being complementary to existing methods for deriving the attractors of Boolean models, while being generic since it applies to any safe Petri net.

MIMETIC Project-Team

6.1. Highlights of the Year

6.1.1. *Link between performance and risk of injury*

Participants: Richard Kulpa [contact], Benoit Bideau, Michaël Ropars.

In our previous biomechanical analysis of the tennis serve, we have demonstrated that the energy flow is a pathomechanical factor, that means that it can increase joint constraints (and thus risk of injury) while not increasing performance. Nevertheless, the definition and evaluation of energy flow is still a complex scientific challenge. We have proposed to compare the energy flow during the serve between injured and non-injured tennis players by investigating the relationships between the quality and magnitude of energy flow, the ball velocity and the peaks of upper limb joint kinetics [11]. The results showed that ball velocity increased and upper limb joint kinetics decreased with the quality of energy flow from the trunk to the 'hand+racket'. Injured players showed a lower quality of energy flow through the upper limb kinetic chain, a lower ball velocity and higher rates of energy absorbed by the shoulder, the elbow than non-injured players. These findings imply that an effective energy flow through the kinetic chain by using a proper serve technique is necessary for reducing overuse joint injury risks.

6.1.2. *ACM SIGGRAPH Course on crowd simulation*

Participant: Julien Pettré [contact].

Crowds for entertainment or safety applications purposes are most of the time simulated using microscopic algorithms. In contrast with other types of approaches, microscopic simulators are able to generate continuous and smooth trajectories for individual agents. They are based on models of local interactions between agents. The crowd motion result form the combination of all local motion and interactions. The fact that the resulting crowd motion is emergent makes difficult anticipating the simulation results. Many motion and interaction models have been proposed to design a plethora of simulation algorithms: force-based models, rule-based models, coupled or not with flow-based models, etc. Each type of interaction models will actually result into specific crowd motions as well as agents trajectories. Unfortunately, not all have the desired properties: oscillations, jerky trajectories, residual collisions or deadlocks are often observed in simulations. From this point of view, the course [28] presents the many recent progresses in crowd simulation algorithms since the introduction of velocity-based algorithms , as well as the impact on the level of realism and the visual quality of simulated crowd motions. It also presents the impact on various kind of applications.

6.1.3. *Immersive basketball playing*

Participants: Franck Multon [contact], Alexandra Covaci, Anne-Hélène Olivier.

The paper has received the best paper award of the ACM VRST 2014 Conference in November 2014. This paper addressed the problem of perception of distances in immersive environments when dealing with precision distant tasks, such as basketball free throw. The work has been done in collaboration with University of Brasov in Romania, thanks to the FP7 VISIONAIR infrastructure project. The main results of this work tend to show that third person perspectives enabled subjects to perform the task with similar movements than in real world, compared to first person perspective. Third person perspective consists in placing the camera at a different place from the eye point of view, as in many videogames. On the opposite first person perspective consists in place the camera at the place of the user's eyes in scale 1:1, as if the user was colocalized in the virtual environment. We also demonsrated an adaptation to the task in immersive environments, which is a key information for future development of training methods using VR. We have been invited to submit an extended version of the paper to the IEEE Computer and Graphics journal for 2015.

BEST PAPERS AWARDS :

[21] **ACM Symposium on Virtual Reality Software and Technology VRST**. A. COVACI, A.-H. OLIVIER, F. MULTON.

MIMOVE Team

6.2. Highlights of the Year

This year has seen the following acknowledgments of the team's contributions:

- Valérie Issarny was distinguished as Chevalier de la Legion d'Honneur for her contributions to science and European scientific cooperation in research and education.

- One of the team's major publication by S. Ben Mokhtar, D. Preuveneers, N. Georgantas, V. Issarny, and Y. Berbers, titled "EASY: Efficient semAntic Service discoverY in pervasive computing environments with QoS and context support" [1], published in the Journal of Systems and Software (Volume 81, Issue 5), is one of the top ten (10) most cited papers among all the papers published by JSS in 2008.

MINT Project-Team

6.1. Highlights of the Year

- "Adoiraccourcix : sélection de commandes sur écrans tactiles multi-points par identification des doigts" [31] received the *best paper award* from the IHM 2014 conference;
- "L'ordinateur portable comme instrument de musique" [41] received the *best demo award* from the IHM 2014 conference.

MISTIS Project-Team

6.1. Highlights of the Year

6.1.1. P-Locus software and Pixyl start-up project

The work on the P-Locus software has been exploited in order to create a start-up in January 2015. The project called Pixyl have been accepted by the GATE1 incubator and has been awarded a BPI emergence prize. It is leaded by Senan Doyle (future CEO). The other co-founders are Michel Dojat (INSERM, GIN), Florence Forbes (Inria, Mistis) and IT-Translation.

MNEMOSYNE Project-Team (section vide)

MOAIS Project-Team (section vide)

MODAL Project-Team

6.1. Highlights of the Year

Thanks to the development technological action MPAGenomics, the team has created one of the first french instances of Galaxy publicly available on the French Bioinformatics cloud. This instance is original as it offers complex statistical tools for genomic data analysis in a user-friendly interface (see 5.9).

The team obtained bilateral contracts with companies as Auchan or RougeGorge thanks to its just emerging, but promising, clustering software MixtComp (see 5.14), dedicated to full mixed and missing data.

MODEMIC Project-Team

6.1. Highlights of the Year

Yeasts play a central role in the wine making process. To study the yeasts in a stable environment and physiological state, a Multi-Stage Continuous Fermentor (MSCF) has been designed by the research Unit SPO (Sciences For Oenology). This device mimics the steps of the batch fermentation process. In this paper, the problem of the control of the sugar concentrations in each of the four reactors of the MSCF is considered. The cascade structure of the device leads to a constraint on the input flow rates (the control variables). A control strategy based on a linearizing control law coupled with a state observer and an anti windup component is proposed and finally implemented on the experimental process (see also 6.3.2).

BEST PAPER AWARD :

[41] **19th IFAC World Congress 2014**. C. CASENAVE, D. DOCHAIN, J. HARMAND, M. PEREZ, A. RAPAPORT, J.-M. SABLAYROLLES.

MOISE Project-Team (section vide)

MOKAPLAN Team

6.1. Highlights of the Year

All of the new results below are important break through and most of them non-incremental research.

Mokaplan has extended its collaborations to several researchers at Ceremade and is under review to become a project team.

MORPHEME Project-Team

5.1. Highlights of the Year

- Laure Blanc-Féraud was General Program chair of the conference IEEE ISBI 2014 in Beijing.

MORPHEO Project-Team (section vide)

MULTISPEECH Team

6.1. Highlights of the Year

The version 2 of our source separation toolbox FASST [65] has been downloaded more than 300 times since its release in January 2014.

MUSE Team (section vide)

MUTANT Project-Team

6.1. Highlights of the Year

Acoustical Society of America Best Paper Award for [20].

International Computer Music Conference (ICMC) Best Presentation Award for [19].

MuTant TEDx Talk in October 2014 on *Human-Computer Musicianship* that attracted more than 12 thousand podcasts according to organisers.

MuTant in CNRS's 2nd edition of "Les Fondamentales" Science and Society event in Grenoble, in a session dedicated to Science and Music on the same Score.

MuTant Participation in the 2014 edition of *Futur en Seine* festival and showcased collaboration with Orchestre de Paris in a public event.

BEST PAPER AWARD :

[19] **International Computer Music Conference**. C. TRAPANI, J. ECHEVESTE.

MYCENAE Project-Team

6.1. Highlights of the Year

- Picture of the Conference poster of the 2014 SIAM annual meeting (July 7-11, Chicago, USA), adapted from [7]

- Invitation to organize the mini symposium "The stochastic brain" at the Stochastic Processes and Applications Conference (Jul 28-Aug1, Buenos-Aires, Argentina)

- Selection of the NeuroMathMod project in the framework of the Sorbonne Université Emergence 2014 call

MYRIADS Project-Team

5.1. Highlights of the Year

- The Contrail project coordinated by Christine Morin received the "Excellent" grade at its final review held on March 14th, 2014 in Brussels.

- Anne-Cécile Orgerie has been awarded the Young Researcher prize of the Lyon city in November 2014.

- Christine Morin has been awarded one of the 12 "Etoile de l'Europe 2014" prizes in December 2014 for the coordination of the Contrail European project.

BEST PAPERS AWARDS :

[18] **4th International Conference on Cloud Computing and Services Science**. H. FERNANDEZ, C. STRATAN, G. PIERRE.

NACHOS Project-Team (section vide)

NANO-D Project-Team (section vide)

NECS Project-Team

6.1. Highlights of the Year

- C. Canudas de Wit serves as General Chair for the Europeen Control Conference (ECC'14), Strasbourg, France, Jul. 2014 (http://www.ecc14.eu/).

- Launch of the SPEEDD EU FP7 project in Feb. 2014.

- Launch of the COMFORT project, which supports the associate Team between Inria project-team NeCS and the Berkeley University project PATH (http://necs.inrialpes.fr/pages/projects/comfort.php).

- Launch of the LOCATE-ME Persyval project (Apr. 2014 to Aug. 2015) in collaboration with the Tyrex team.

- The team has organized the Hycon2 Show day in May 2014 (http://www.inria.fr/en/centre/grenoble/calendar/hycon2-show-day-traffic-modeling-estimation-and-control).

NEUROMATHCOMP Project-Team

5.1. Highlights of the Year

Olivier Faugeras received the Okawa prize for his pioneering contributions for computer vision and for computational neuroscience. The ceremony will be held in Tokyo in March 2015.

NEUROSYS Team

6.1. Highlights of the Year

Microscopic action affects mesoscopic and macroscopic action in neural systems. In the context of general anaesthesia, it is not understood how single neuron properties, such as ion-channel conductivities or anesthestic action on neuron receptors, translate to population dynamics and consequently to behavior. The work of Laure Buhry and Axel Hutt [4] proposes a modelling approach how to bridge the microscopic and the mesoscopic scale. The most interesting aspect is that this model bridge allows to extend standard neural field theory on the mesoscopic scale instead of introducing a new model.

In addition, we have developed strong collaborations with medical doctors. First, we have established a collaboration with Dr. Denis Schmartz and Dr. Claude Meistelmann at the *CHU Nancy* to plan and perform well-controlled resting state experiments under propofol anaesthesia. Second, we are in close contact to Jean-Luc Schaff at the *CHU Nancy* (together with Laurent Koessler at *CRAN*) in the context of sleep monitoring. Dr. Schaff has provided us polysomnographic data measured during sleep of insomnia patients.

NON-A Project-Team

6.1. Highlights of the Year

- We are becoming world-recognized on homogeneous approach to estimation and control [13], [24].
- New method of stability analysis and control design for time-delay systems: Implicit Lyapunov-Krasovski Functionals [72].
- New dynamical model of population of oysters for water quality monitoring [44].
- New local path planning algorithm for mobile robots based on intermediate objectives [33].
- New patent on method and device for detecting a failure on an aircraft [85].
- New book on robust control design [82].

NUMED Project-Team

5.1. Highlights of the Year

Vincent Calvez has been awareded an ERC Grant and the prestigious Bronze medal CNRS.

OAK Project-Team

6.1. Highlights of the Year

The year has allowed reaching important results in four research areas of the group: query-based why-not provenance with explanations , minimal query reformulations under constraints [14], Linked Open Data analytics , and RDF data management in the cloud .

BEST PAPERS AWARDS :

[6] **Extending Database Technology (EDBT)**. N. BIDOIT, M. HERSCHEL, K. TZOMPANAKI.

[10] **23rd International World Wide Web Conference**. D. COLAZZO, F. GOASDOUÉ, I. MANOLESCU, A. ROATIS.

[], [23] **The International Journal on Very Large Databases**. Z. KAOUDI, I. MANOLESCU.

OPALE Project-Team

6.1. Highlights of the Year

Paola Goatin was awarded the *"Prix Inria - Académie des sciences du jeune chercheur"*.

ORPAILLEUR Project-Team

6.1. Highlights of the Year

As highlights of the year, we would like to mention several elements, an award in a competition and a best paper. In addition we would like to also mention the importance gained by two other papers.

- Yen Low, a postdoctoral fellow from Stanford and Adrien Coulet (Orpailleur team) jointly developed a prototype named *Whypothesis?* whose goal is to provide explanations on drug side effects for which the molecular mechanism remains unknown. This prototype won the "Best Application Award" at the 2014 NCBO Hackathon (National Center for Biomedical Ontology), held at Stanford University, April 26-27 (http://www.bioontology.org/2014_NCBO_Hackathon).

- The paper [2] describing a first and original proposition for combining pattern structures and relational concept analysis won the best paper award at the International Conference on Formal Concept Analysis in Cluj-Napoca, Romania.

- The paper [10] published in Nucleic Acids Research describes the latest version of KBDOCK, which has had over 12,000 non-duplicate visitors since 2011.

- The paper [44] on polypharmacology represents a nice collaboration with Harmonic Pharma, and it was used for the cover issue of Journal Chemical Information (http://pubs.acs.org/toc/jcisd8/54/3).

BEST PAPER AWARD :

[56] **Formal Concept Analysis - 12th International Conference - Proceedings**. V. CODOCEDO, A. NAPOLI.

PANAMA Project-Team

6.1. Highlights of the Year

The EUSIPCO 2014 Best Student Paper Award was awarded to our joint paper [32] on dynamic screening for sparse regularization. .

A review paper on audio source separation, rooted in METISS/PANAMA know-how and contributions to this topic over the years, was published in the IEEE Signal Processing Magazine [25].

A new version of the Flexible Audio Source Separation Toolbox (FASST) was released in January 2014 and downloaded 300 times.

BEST PAPERS AWARDS :

[32] **European Signal Processing Conference EUSIPCO 2014**. A. BONNEFOY, V. EMIYA, L. RALAIVOLA, R. GRIBONVAL.

PAREO Project-Team (section vide)

PARIETAL Project-Team

6.1. Highlights of the Year

- Congratulations also to Alex and Daniel Strohmeier for their best paper award at the PRNI 2014 conference: "Improved MEG/EEG source localization with reweighted mixed-norms".
- Elvis Dohmatob got a honorable mention for the student paper award at PRNI 2014 for the work "Benchmarking solvers for TV-l1 least-squares and logistic regression in brain imaging"

PARKAS Project-Team

6.1. Highlights of the Year

The paper *ReactiveML, a reactive extension to ML* of Mandel and Pouzet has been declared to be the *most influential paper of PPDP (Principles and Practice of Declaractive Programming) 2005*. A previous version of the paper, submitted to JFLA'05, has been declared to be "une contribution marquante parmi les articles publiés aux JFLA".

PARSIFAL Project-Team

6.1. Highlights of the Year

Dale Miller's 1994 LICS paper titled "A Multiple-Conclusion Meta-Logic" [67] was a co-recipient of the LICS Test of Time Award.

PERCEPTION Project-Team

5.1. Highlights of the Year

- In 2014 Antoine Deleforge (team member 2009-2013) received the **Signal, Image and Vision best PhD prize** for his thesis *"Acoustic Space Mapping: A Machine Learning Approach to Sound Source Separation and Localization"*, defended in December 2013 and advised by Radu Horaud. The prize is jointly awarded by GDR ISIS, Club EEA, and GRETSI.

  Website: http://www.inria.fr/centre/grenoble/actualites/apprendre-a-rester-attentif-a-ses-locuteurs

- Radu Horaud was awarded an **ERC Advanced Grant** for his five year project VHIA *"Vision and Hearing in Action"*, grant number 340113, 2014-2019.

  Website: https://team.inria.fr/perception/vhia/.

- The PERCEPTION team was awarded an **ANR BLANC** two year project MIXCAM *"Real-Time Visual Reconstruction by Mixing Multiple Depth and Color Cameras"*, in collaboration with 4D View Solutions, 2014-2016.

  Website: https://team.inria.fr/perception/mixcam-project/

- The PERCEPTION team was awarded an **FP7 STREP** three year project EARS *"Embodied Audition for Robots"*, in collaboration with Friedrich Alexander Universiteit, coordinator (Germany), Ben Gurion University (Israel), Imperial College (UK), Humboldt University Berlin (Germany) and Aldebaran Robotics (France), 2014-2017.

  Website: https://team.inria.fr/perception/ears/

PHOENIX Project-Team

6.1. Highlights of the Year

- A best paper award was obtained at ASSETS 2014 (The 16th International ACM SIGACCESS Conference on Computers and Accessibility), by the 5 authors of the paper "Tablet-Based Activity Schedule for Children with Autism in Mainstream Environment" .

BEST PAPERS AWARDS :

[26] **ASSETS 2014 - The 16th International ACM SIGACCESS Conference on Computers and Accessibility**. C. FAGE, L. POMMEREAU, C. CONSEL, E. BALLAND, H. SAUZÉON.

PI.R2 Project-Team

5.1. Highlights of the Year

We successfully organised the thematic trimester Semantics of Proofs and Certified Mathematics (IHP, April-July 2014). The trimester attracted over two hundred participants altogether (with about 60 "resident" participants staying a month or more), hosted 5 special workshops, as well as other related regevents such as Types, MAP (Mathematics, Algorithms, and Proofs). It was the first thematic trimester in the history of IHP to feature computer science prominently. There was a kick-off day on April 22, with talks of Georges Gonthier, Thomas Hales, Xavier Leroy, and Vladimir Voevodsky, with the presence of some science journalists. During the trimester, the Bourbaki Seminar devoted an afternoon (June 21) to these themes, with talks of Thomas Hales and Thierry Coquand.

Shortly before, Coq has received the Software System Award 2013 from the Association for Computing Machinery (ACM). Hugo Herbelin is one of the recipients of this prize.

POEMS Project-Team (section vide)

POLSYS Project-Team

6.1. Highlights of the Year

Jointly with Univ. Of Kaiserslautern (C. Eder), we have released a new open source C library for linear algebra dedicated to Gröbner bases computations (see http://www-polsys.lip6.fr/~jcf/Software/index.html). This new library opens the door to high performance applications

- The library is specialized in reducing matrices generated during Gröbner bases computations. Optimizing this reduction step is crucial for the overall computation.

- Our approach takes even more advantage of the very special structure (quasi unit-triangular sparse matrices with patterns in the data)

- We also reduce the number of operations, in a parallel friendly fashion, by changing the order of the operations in the elimination.

- We present experimental results for sequential and parallel computations on NUMA architectures. We also get good scaling up until 32 (non hyper-threaded) cores: we have speed-ups around 14 or 16.

POMDAPI Project-Team (section vide)

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

6.1. Highlights of the Year

Marc Lavielle published the book, *Mixed Effects Models for the Population Approach: Models, Tasks, Methods and Tools* (Chapman & Hall/CRC), which presents a rigorous framework for describing, implementing, and using mixed effects models. With these models, readers can perform parameter estimation and modeling across a whole population of individuals at the same time.

POSTALE Team

5.1. Highlights of the Year

CovTrack: Agile multi-target multi-threaded realtime tracker   We have developed and highly optimized a multi-target tracking system based on covariance tracking algorithm. The complexity of the algorithm – connected to the number of features – can be tuned to fit the processor computation power (with/without SIMD). Moreover the features can be also selected from a large set of features to adapt the algorithm to the scene and the nature of tracking (indoor/outdoor, pedestrian/car,). Some software and algorithmic transforms have been also applied to accelerate the code for scalar/SIMD processors. [20]

The Light Speed Labeling (LSL) algorithm   is still the world fastest connected component labeling (CCL) algorithm. We have proposed a new benchmark that performs fair comparisons for such a data-dependent algorithm (that involves Union-Find algorithm optimization combined with memory and control flow optimization). We show that thanks to its run-based approach and its line-relative labeling, LSL is intrinsically more efficient that all State-of-the-Art pixel-based algorithms, whatever the memory management.[23]

POTIOC Project-Team

6.1. Highlights of the Year

- Acceptance of the ANR project "ISAR" (Interacting with Spatial Augmented Reality) lead by Martin Hachet (Potioc)
- Publication of "Teegi" (Tangible EEG Interface) at UIST14 [15] and more than 13000 views on vimeo until December 2014 (http://vimeo.com/potioc/teegi)

PRIMA Project-Team

5.1. Highlights of the Year

On March 14, 2014, James Crowley was named Chevalier de l'Ordre national du Mérite.

On August 2014, the paper "Human-Robot Motion: an Attention-Based Navigation Approach" [14] by Thierry Fraichard, Remi Paulin & Patrick Reignier has been nominated for the best paper award at the IEEE Int. Symp. on Robot and Human Interactive Communication (RO-MAN 2014), Edinburgh (UK).

On December 2014, Patrick Reignier was a member of the EDF grand jury for smart energy

BEST PAPER AWARD :

[14] **IEEE Int. Symp. on Robot and Human Interactive Communication (ROMAN)**. T. FRAICHARD, R. PAULIN, P. REIGNIER.

PRIVATICS Project-Team

5.1. Highlights of the Year

Vincent Roca was awarded the 3rd Applied Research price of the Fédération des Industries Electriques, Electroniques et Communications (FIEEC), for his transfer activities to the Expway French SME, Lyon, October 8th, 2014.

The team got two major contributions:

- *A Case Study: Privacy Preserving Release of Spatio-temporal Density in Paris* was published by Gergely Acs and Castelluccia at KDD 2014.

- *Censorship in the Wild: Analyzing Internet Filtering in Syria* was published by Chaabane Abdelberi, Mathieu Cunche,and Mohamed Ali Kaafar at IMC 2014.

PROSECCO Project-Team

6.1. Highlights of the Year

This year, we published 17 articles in international peer-reviewed journals and conferences, including papers in prestigious conferences such as POPL (2 papers) and all the top conferences in computer security: IEEE S&P Oakland (2 papers), CRYPTO, ACM CCS, NDSS, and Financial Cryptography. Our papers in these top venues (discussed later in New Results) serve as highlights of our research during the year. In addition to these papers, we published 1 PhD thesis and several technical reports.

We released updates to miTLS, ProVerif, CryptoVerif, and started working on a brand-new version of F*. We discovered serious vulnerabilities in a number of TLS libraries, web browsers, and web servers, resulting in 6 published CVEs, and over a dozen software updates based on our recommendations in widely used software such as Firefox, Chrome, Internet Explorer, Safari, OpenSSL, Java, and Mono.

We organized a winter school "The Joint EasyCrypt-F*-CryptoVerif School 2014" which attracted industrial researchers, academics, and students from around the world. Over 75 students learned to use cryptographic verification tools from instructors at Inria, IMDEA, and Microsoft Research. Two of the tools: CryptoVerif and F* are being developed in collaboration with Inria.

If we were to choose one research theme as our highlight of the year, it would be our activities surrounding Transport Layer Security (TLS):

- At CRYPTO 2014, we published a detailed cryptographic proof of the TLS handshake as implemented in miTLS

- At NDSS 2014, we published a study in the use of X.509 certificates in TLS servers on the web

- At IEEE S&P (Oakland), we published a new attack on the TLS protocol called the *triple handshake*, which affected all TLS libraries and mainstream TLS applications such as web browsers.

- To prevent our attack, we proposed patches to major software libraries as part of responsible disclosure. Our research directly led to security updates for all major web browsers and TLS implementations.

- We also proposed a long-term countermeasure for our attack, the TLS Session Hash extension, which we published as an internet draft and presented at the IETF. This draft is on its way to being a published standard and is already implemented in all major TLS libraries.

- We participated in the design of next version (1.3) of the TLS protocol. We hosted an interim TLS working group meeting in Paris. Our proposals such as the session hash construction are now an integral part of the new design, and we continue consulting on the design and implementation of TLS.

QUANTIC Team

5.1. Highlights of the Year

- Experimental results in continuous measurement of error syndromes for a quantum error correction scheme developed by Mazyar Mirrahimi and his former PhD student Zaki Leghtas in close collaboration with the teams of Michel Devoret and Robert Schoelkopf (Department of Applied Physics of Yale University) have been published in Nature [13].

- Theoretical proposal on a new paradigm for universal quantum computation [12] has been chosen by the editors of the New Journal of Physics as an IOPselect paper for the novelty, significance and potential impact on future research.

- The EPOQ2 ANR Young Researcher project, led by Mazyar Mirrahimi, was highlighted in the 2013 annual report of Agence Nationale de la Recherche.

RAP Project-Team (section vide)

REALOPT Project-Team

6.1. Highlights of the Year

- Olivier Beaumont and Lionel Eyraud-Dubois have received the HiPC best paper award for their work on resource allocation for large scale virtualized platforms with reliability guarantees. They provided a formulation based on a thorough analysis of a real life usage trace, and a very efficient two-step allocation algorithm.

- The team organized the annual conference of the French Operations Research Society ROADEF14 in Feb 2014.

- An Inria Innovation Lab has been created between Realopt and Ertus Consulting.

- The SAMBA associated team project with Brazil was renewed for 3 years including new collaborators from Chili.

- François Vanderbeck was invited as a plenary speaker at the conference OPTIMIZATION 2014, in Portugal [19].

REGAL Project-Team

5.1. Highlights of the Year

- *Garbage collection for big data on large-memory NUMA machines*. We developed NumaGiC, a high-throughput garbage collector for big-data algorithms running on large-memory NUMA machines (see Section 4.1). This result, a collaboration with the Whisper team, will be presented at ASPLOS 2015 [29].

- *Explicit consistency*. We propose an alternative approach to the strong-vs.-weak consistency conundrum, *explicit consistency*. Static analysis identifies precisely what is the minimal amount of synchronisation that is necessary to maintain the invariants required by an application (see Section 5.3.11). This result will be presented at EuroSys 2015 [53].

- *Lower bounds and optimality for CRDTs*. This is the first paper to study the inherent lower bounds of replicated data types. The contribution includes derivation of lower bounds for several data types, improvement of some implementations, and proved optimality of others (see Section 5.3.10). This result was presented at POPL 2014 [25].

REGULARITY Project-Team

6.1. Highlights of the Year

The article "Christiane's Hair" by Jacques Lévy-Véhel and Franklin Mendivil has received the Paul R. Halmos - Lester R. Ford award of the Mathematical Association of America.

REO Project-Team

6.1. Highlights of the Year

- Jimmy Mullaert was awarded the best poster prize at the conference Canum 2014.
- Jessica Oakes was awarded a University of California Presidential Postdoctoral Fellowship.
- Jessica Oakes won a young investigator award at the "4th International Conference on Engineering Frontiers in Pediatric and Congenital Heart Disease".

REVES Project-Team

6.1. Highlights of the Year

Our work on sketch-based modeling for product designers (Sec. 6.4.4) has received significant attention. It appeared on the news page of University of British Columbia http://news.ubc.ca/2014/08/13/powerful-math-creates-3-d-shapes-from-simple-sketches/ and our video has been watched more than 7000 times on Youtube http://youtu.be/tbUljHJv4Rg. We filed a patent on this technology and we have contacts with several companies about a potential transfer.

Our poster on *C-LOD: Context-aware Material Level-of-Detail applied to Mobile Graphics* [] received the 3rd place in the ACM's Graduate Student Research Competition at SIGGRAPH 2014. This work is a collaboration with George Alex Koulieris and Katerina Mania from the Technical University of Crete and Douglas Cunningham from the Technical University of Cottbus.

BEST PAPER AWARD :

[] **Computer Graphics Forum**. G. A. KOULIERIS, G. DRETTAKIS, D. W. CUNNINGHAM, K. MANIA.

RITS Team

6.1. Highlights of the Year

YoGoKo [0], a startup company of RITS, was founded in 2014 by employees from three research institutes: Mines ParisTech, Telecom Bretagne and Inria. YoGoKo makes use of softwares developed in teams specialized in Internet technologies. RSM (Telecom Bretagne), CAOR (Mines ParisTech) and RITS (Inria) are research teams have been working together since 2006 on innovative communication solutions applied to Intelligent Transportation Systems. They contributed to several collaborative R& D projects related to ITS (CVIS, ITSSv6, GeoNet, DriveC2X, SCORE@F, ...). In 2012, these laboratories engaged together into the development of a common demonstration platform which comprises connected vehicles (fleet of conventional vehicles from Mines ParisTech and fleet of autonomous vehicles from Inria), roadside equipments and cloud-based services. YoGoKo demonstration platform was finally revealed on Feb. 11 th 2014 during the Mobility2.0 event organized by the French Ministry of Transport. This successful demonstation and the extremely warmfull feedack gained at this occasion triggered the launch of YoGoKo as a company. YoGoKo develops innovative communication solutions for fixed and mobile multi-connected devices. The objective is to maintain secure and continuous connectivity with their communication peers, either in their immediate environment or a remote location (control centers or Internet hosts).

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[0] http://www.yogoko.fr/

RMOD Project-Team

6.1. Highlights of the Year

- Pharo 3.0 has been released in April 2014.
- Moose 5.0 has been released in December 2014.
- The book Deep into Pharo has been released publicly http://www.deepintopharo.com.
- RMOD entered in a sponsoring agreement with LAM Research, Inc.

ROMA Team

6.1. Highlights of the Year

Yves Robert was awarded the 2014 IEEE Technical Committee on Scalable Computing (TCSC) Award for Excellence.

In October 2014, CERFACS, ENS Lyon, INPT, Inria and University of Bordeaux launched a consortium around the software package MUMPS (see http://mumps-consortium.org).

RUNTIME Team

6.1. Highlights of the Year

- This year we started very large collaborations with the BULL/Atos company. WE started one European project, one PIA french project and one PhD thesis. The amount of Person Year funded with this project exceed 10. The research we will do with Bull covers resource management, process placement, platform modeling, application modeling, affinity abstraction.

- The StarPU software is used by CEA for automatically distributing linear algebra on their cluster of 144 hybrid nodes.

SAGE Project-Team

6.1. Highlights of the Year

Lionel Lenôtre and his co-authors revisited in a very efficient way the Hastings-Metropolis Algorithm on Markov Chains for Small-Probability Estimation.

SCALE Team (section vide)

SECRET Project-Team

6.1. Highlights of the Year

- Rafael Misoczki's PhD thesis on code-based cryptography (defended in November 2013) has been awarded by the Brazilian Society of Computer Science as the best thesis in computer security.

- *Security analysis of some primitives for authentication and authenticated encryption:* authentication is a major functionality in the vast majority of applications. It is usually implemented by a MAC (message authentication code). The main constructions for MAC are based on hash functions, and include the wide-spread HMAC construction. Gaëtan Leurent, together with Itai Dinur, has presented a new generic attack against HMAC when the underlying hash function follows the Haifa construction. This result points out that the hash function in HMAC has to be chosen very carefully and that some of the main families of hash functions may introduce unexpected weaknesses in the associated MAC. Also, the project-team is involved in a national cryptanalytic effort funded by the ANR which aims at evaluating the security of the recently proposed authenticated encryption schemes.

- *Parallel Repetition of Entangled Games:* In a two-player free game G, two cooperating but non communicating players receive inputs taken from two independent probability distributions. Each of them produces an output and they win the game if they satisfy some predicate on their inputs/outputs. The classical (resp. entangled) value of G is the maximum winning probability when the players are allowed to share classical random bits (resp. a quantum state) prior to receiving their inputs. The n-fold parallel repetition of G consists of n instances of G where the parties receive all the inputs at the same time, produce all the outputs at the same time and must win every instance of G. This work by André Chailloux in collaboration with Giannicola Scarpa establishes that the entangled value of the parallel repetition of G decreases exponentially with n, thereby generalizing to the quantum setting Raz's celebrated parallel repetition theorem which is concerned with the classical value of the game. The main tool for proving this result is the introduction of a new information-theoretic quantity: the superposed information cost.

SELECT Project-Team (section vide)

SEMAGRAMME Project-Team (section vide)

SEQUEL Project-Team

6.1. Highlights of the Year

- New startup by Rémi Coulom on AI in games (go, chess, · · ·).
- Successful Collaboration with Deezer and the victory at the ACM RecSys Recommendation Systems Challenge
- We were selected and working on preparation of ICML 2015 in Lille. ICML is the most important conference in the field of machine learning. This is the first time after more than 30 years of existence, that this conference will be held in France.

SERPICO Project-Team (section vide)

SHACRA Project-Team

5.1. Highlights of the Year

5.1.1. Intra-operative guidance

Each year in Europe 50,000 new liver cancer cases are diagnosed for which hepatic surgery combined to chemotherapy is the most common treatment. In particular the number of laparoscopic liver surgeries has increased significantly over the past years. Minimally invasive procedures are challenging for the surgeons due to the limited field of view.

Providing new solutions to assist surgeons during the procedure is of primary interest. This year, the team developed an innovative system for augmented reality in the scope of minimally invasive hepatic surgery. The first issue is to align preoperative data with the intra-operative images. We first proposed a semi-automatic approach [28] for solving the ill-posed problem of initial alignment for augmented reality systems during liver surgery. Our registration method relies on anatomical landmarks extracted from both the laparoscopic images and a three-dimensional model, using an image-based soft-tissue reconstruction technique and an atlas-based approach, respectively.

Second, we introduced a method for tracking the internal structures of the liver during robot-assisted procedures [25]. Vascular network, tumors and cut planes, computed from pre-operative data, can be overlaid onto the laparoscopic view for image-guidance, even in the case of large motion or deformation of the organ. This is made possible by relying on a fast yet accurate 3D biomechanical model of the liver combined with a robust visual tracking approach designed to properly constrain the model. Our augmented reality proved to be accurate and extremely promising on in-vivo sequences of a human liver during robotic surgery.
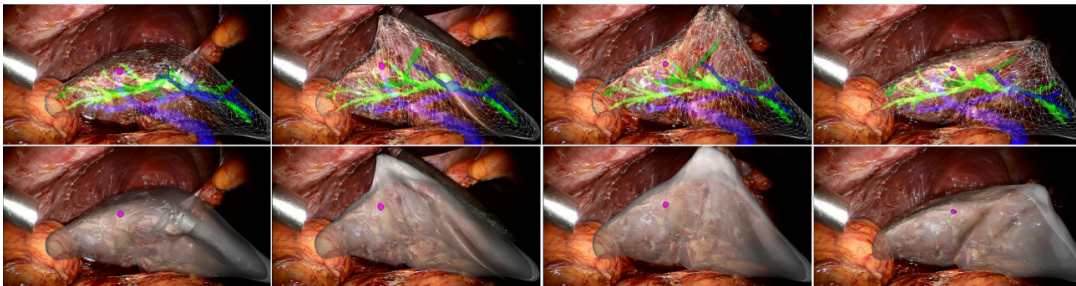

Figure 4. Augmented reality on the liver with 3D visualization of the blood vessels

5.1.2. Ph.D. defenses

The year 2014 was also special since many PhDs have been defended. Four PhD defenses took place with:

- Ahmed Yureidini's defense about *Robust blood vessel surface reconstruction for interactive simulations from patient data* [15] in May 2014,
- Guillaume Kazmitcheff's defense about *Minimal invasive robotics dedicated to otological surgery* [13] in June 2014,
- Hugo Talbot's defense about *Interactive patient-specific simulation of cardiac electrophysiology* [14] in July 2014,
- Alexandre Bilger's defense about *Patient-specific biomechanical simulation for deep brain stimulation* [12] in December 2014.

5.1.3. Organization of ISBMS 2014

The team co-organized the 6th International Symposium on Biomedical Simulation (ISBMS) 2014, which was held in Strasbourg (France) on October 16 – 17, 2014. The ISBMS conference is a well-established scientific meeting that provides an international forum for researchers interested in using biomedical simulation technology for the improvement of patient care and patient safety. The SiMMS group from Imperial College London and IHU-Strasbourg were the two other co-organizers. The event was hosted at IRCAD, a center of excellence in surgical training. The ISBMS chairs were:

- Stéphane Cotin (Inria),
- Fernando Bello (Imperial College London),
- Jérémie Dequidt (Univ. Lille),
- Igor Peterlik (IHU Strasbourg & Masaryk Univ.).

The whole team was involved in the organization of the event. About 65 participants joined the conference. Regarding their feedback, the conference was a real success. For more information about ISBMS, refer to the official website http://www.isbms.org.

Finally, a day dedicated to our software SOFA ("SOFA Day") was organized the day after the ISBMS conference. This was the opportunity to introduce SOFA to the ISBMS community and to share with the SOFA users.

(a) Setup of our demo   (b) With Genevieve Fioraso

Figure 5. Presentation of our work at the French National Assembly. Genevieve Fioraso is the French national research secretary

5.1.4. Demonstration at the French National Assembly

On Tuesday 21st January 2014, the team SHACRA presented its work during the "Internet et société numérique" working group. This was a joint event between Inria and the French National Assembly (Assemblée Nationale). On this special occasion, we made a demonstration of our simulations and the CEO from Inria Michel Cosnard also presented more globally the role of Inria in healthcare but also education, cloud computing, big data.

SIERRA Project-Team (section vide)

SIROCCO Project-Team (section vide)

SISTM Team

6.1. Highlights of the Year

A work (described below), in collaboration with M. Davis and R. Tibshirani from Standford University, has been published in the "Proceedings of the National Academy of Sciences" : [8].

Females have generally more robust immune responses than males for reasons that are not well-understood. Here we used a systems analysis to investigate these differences by analyzing the neutralizing antibody response to a trivalent inactivated seasonal influenza vaccine (TIV) and a large number of immune system components, including serum cytokines and chemokines, blood cell subset frequencies, genome-wide gene expression, and cellular responses to diverse in vitro stimuli, in 53 females and 34 males of different ages. We found elevated antibody responses to TIV and expression of inflammatory cytokines in the serum of females compared with males regardless of age. This inflammatory profile correlated with the levels of phosphorylated STAT3 proteins in monocytes but not with the serological response to the vaccine. In contrast, using a machine learning approach, we identified a cluster of genes involved in lipid biosynthesis and previously shown to be up-regulated by testosterone that correlated with poor virus-neutralizing activity in men. Moreover, men with elevated serum testosterone levels and associated gene signatures exhibited the lowest antibody responses to TIV. These results demonstrate a strong association between androgens and genes involved in lipid metabolism, suggesting that these could be important drivers of the differences in immune responses between males and females.

SISYPHE Project-Team (section vide)

SMIS Project-Team (section vide)

SOCRATE Project-Team

6.1. Highlights of the Year

6.1.1. FIT/CortexLab Inauguration

FIT(Future Internet of Things) is a french Equipex (Équipement d'excellence) which aims to develop an experimental facility, a federated and competitive infrastructure with international visibility and a broad panel of customers. FIT is be composed of four main parts: a Network Operations Center (NOC), a set of Embedded Communicating Object (ECO) test-beds, a set of wireless OneLab test-beds, and a cognitive radio test-bed (CorteXlab) deployed by the Socrate team in the Citi lab. In 2014 the construction of the room was finished see Figure 5 . SDR nodes have installed in the room, 42 industrial PCs (Aplus Nuvo-3000E/P), 22 NI radio boards (USRP) and 18 Nutaq boards (PicoSDR, 2x2 and 4X4) can be programmed from internet now.

A very successfully inauguration took place on the 28th October 2014 [0], with the noticable venue of Vincent Poor, Dean of School of Engineering and Applied Science of Princeton University.
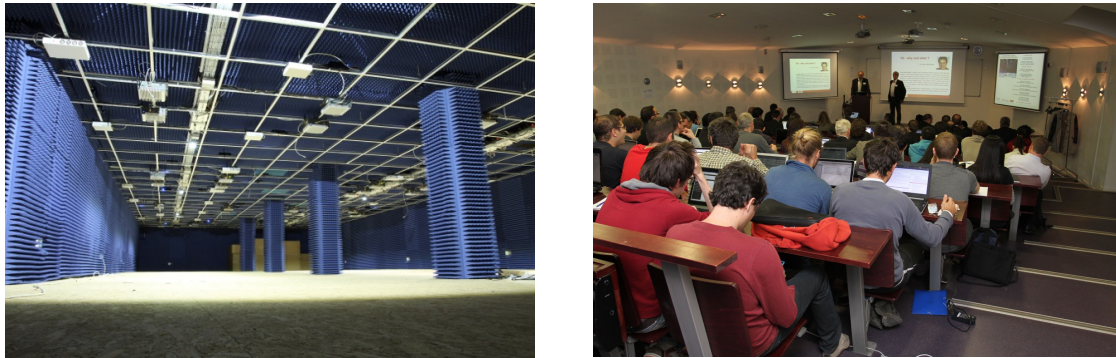

Figure 5. Photo of the FIT/CortexLab experimentation room installed and a snaptshot of the inauguration meeting

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[0]http://www.inria.fr/centre/grenoble/actualites/inauguration-reussie-de-la-plateforme-cortexlab-equipex-fit

SPADES Team (section vide)

SPECFUN Project-Team

6.1. Highlights of the Year

Two results are particularly important this year, our computer-checked proof [11] of irrationality of $\zeta(3)$ and our new algorithm [19] for the integration of multiple integrals. The former is our first success in the merger between computer algebra and formal methods, and stimulates further research in this direction around special functions and creative telescoping. The latter has made a large class of integrals possible in practice, thus allowing us to compute a challenging list of integrals related to famous Calabi–Yau various; it has also received attention by physicists.

SPIRALS Team

6.1. Highlights of the Year

In 2014, we are proud to have organized the 17th ACM SIGSOFT International Conference on Component-Based Software Engineering and Software Architecture (CompArch) that has been held in Lille from 30 June to 3 July 2014.

CompArch is the main conference of the ACM SIGSOFT group on software architectures and software components. The conference is held alternatively in North America and in Europe. The 17th edition has been held this year in France for the first time. The conference brings together about 100 researchers from the academia and the industry.

STARS Project-Team

6.1. Highlights of the Year

NeoSensys, a spin off of the Stars team which aims at commercializing video surveillance solutions for the retail domain, has been created in September 2014.

STEEP Team

6.1. Highlights of the Year

This year has seen a number of major advances in the team research projects, on several fronts. The first one concerns the most important and time consuming project, namely integrated land use, activity and transport modelling (LUTI modelling). In this respect, the results described in 6.8 below constitute probably the first set of works contributing sophisticated numerical procedures to the calibration and validation of the TRANUS LUTI model.

The second significant breakthrough concerns the completion of a downscaling methof for Material Flow Analysis (MFA), a key aspect in the characterization and understanding of territorial metabolism for decision-help purposes (section 6.2).

Finally, the modelling effort on land use change for the ESNET project has now been mostly completed, and an operational LUCC model has been calibrated and validated for this project (section 6.3).

SUMO Project-Team

6.1. Highlights of the Year

We started our first industrial collaboration "Project P22" with Alstom Transport, in the context of a common laboratory between Inria and Alstom. The project started in March 2014 and tackles robustness issues and regulation in urban train systems. The second phase of the project will start in march 2015, for a duration of three years. Most of the researchers of Sumo are involved in this project.

TACOMA Team (section vide)

TAO Project-Team

6.1. Highlights of the Year

- The European commission has chosen Crystal-Supergrids (http://www.artelys.com/news/120/90/Energy-The-European-Commission-Chooses-Artelys-Crystal) for energy modeling and planning in Europe. Crystal-Supergrids is based on the Post project, an ADEME project between Artelys and Inria-TAO.

- The HiggsML challenge was the all-time most popular challenge organized by Kaggle. Cécile Germain-Renaud, Balázs Kégl and Marc Schoenauer were part of the organizing committee.

- Creation of the Center for Data Science, an interdisciplinary institute of the Université Paris-Saclay. Co-chaired by Balázs Kégl, with more than 250 permanent researchers in 35 laboratories, the CDS organizes continued cross-fertilization of machine learning and domain sciences.

- Best Paper Award at PPSN .

BEST PAPERS AWARDS :

[36] **13th International Conference on Parallel Problem Solving from Nature**. I. LOSHCHILOV, M. SCHOENAUER, M. SEBAG, N. HANSEN.

TASC Project-Team

6.1. Highlights of the Year

In the context of the MiniZinc Challenge and in concurrency with 16 other solvers, CHOCO has won three bronze medals in three out of four categories: free search, parallel search and Open class.

TEA Project-Team

6.1. Highlights of the Year

This year's effort has been mainly devoted to the successful creation of project-team TEA and the definition of its new research perspective on Time, Events and Architectures in CPS design.

The SAE committee on the AADL adopted our recommendations to implement a timed and synchronous behavioural annex [13], [11] for standardisation [20]. The specification and reference implementation of this revised behavioral annex will be the focus of most our attention next year.

Adnan Bouakaz published and implemented more of the original results from his PhD. work on abstract affine scheduling [14], [15].

TEMPO Team

6.1. Highlights of the Year

The project was created.

TITANE Project-Team (section vide)

TOCCATA Project-Team

6.1. Highlights of the Year

- The ACM Software System Award 2013 was given, during a ceremony in June 2014 in San Francisco, to the Coq proof assistant (http://awards.acm.org/software_system/). The prestigious ACM price was previously awarded to the LLVM compiler infrastructure (2012) and to the Eclipse IDE (2011). Among the 9 recipients of the 2013 award are Christine Paulin and Jean-Christophe Filliâtre, from the Toccata team.

- The *Concours Castor informatique* (http://castor-informatique.fr/) had an even larger success than in the previous years. In November 2014, more than 228,000 teenagers from over 1500 schools participated and solved the interactive tasks of the contest. Arthur Charguéraud and Sylvie Boldo, from the Toccata team, significantly contributed to the prepation of the tasks and to the organization of the contest.

TONUS Team

6.1. Highlights of the Year

We have implemented an OpenCL task graph version of our Discontinuous Galerkin solver that allows to overlap GPU computations and MPI communications. With this optimizations, we were recently able to achieve a 14 GFLOPS simulation with 8 GPUs on an electromagnetic test case. These results are included in the PhD of Thomas Strub (defence planned in March 2015) under the supervision of Philippe Helluy.

TOSCA Project-Team (section vide)

TYREX Project-Team (section vide)

URBANET Team

6.1. Highlights of the Year

Two scientific results can be distinguished in UrbaNet activity this year. First of all, the work did in collaboration with Orange Labs during the PhD thesis of O. Erdene-Ochir (defended in 2013) led to a patent [38] related to routing in wireless sensor networks under resiliency constraints.

A second important result is represented by the book chapter "Wireless Access Networks for Smart Cities" [31], a common contribution of all the permanent members of the team. We hope that this chapter will become the reference on wireless networking within the new and dynamic smart cities community.

VEGAS Project-Team (section vide)

VERIDIS Project-Team

6.1. Highlights of the Year

The veriT solver (section 5.1) participated in the SMT competition 2014, part of the Vienna Summer Of Logic Olympic Games, and received the gold medal for the SMT category.

VIRTUAL PLANTS Project-Team

5.1. Highlights of the Year

- Publication of a joint work with RDP at ENS-Lyon in the journal 'Nature'. In December 2013, a joint work on phyllotaxy with the RDP lab from ENS-Lyon was published online in the journal Nature [2]. This paper obtained the 2014 prize "la Recherche" in the biology category http://www.leprixlarecherche.com. Based on the analysis of phyllotaxis perturbations in mutants, this study sheds a new light on our interpretation of phyllotaxis, revisiting the standard model and suggesting that several fields based on auxin and cytokinin with different properties are required to provide robustness to phyllotaxis.

- To study and model morphogenesis, the team has been working in the last 8 years on modeling mechanical forces and deformations in tissues in collaboration with the UMR RDP at ENS-Lyon. This work has given rise to the development of a 3D computational framework to model the mechanics of 3D plant tissues during growth at cellular resolution and has been finalized this year with a publication in PLoS Comp. Biology (to appear in 2015). This framework makes it possible to construct models of meristem development, showing how the regulation of regional identities can lead to realistic shape development by dynamically modulating the mechanical properties of cells. It has been used also to study the influence of a specific signalling cascade (the ABP1-Kat1 signalling pathway) and its putative mechanical consequences on primordium initiation [25]. The expertize gained by our groups on physical models of plant tissue development has been wrapped up in a review paper [12].

VISAGES Project-Team

6.1. Highlights of the Year

Dr Camille Maumet was awarded by the French Society of Magnetic Resonance in Biology and Medicine (SFRMBM) for her PhD Thesis on analysis of neuroimaging data including images from functional Magnetic Resonance Imaging (fMRI) and Arterial Spin Labeling http://www2.warwick.ac.uk/fac/sci/wmg/idh/idhnews/?tag=Neural+Engineering.

Dr Americ Stamm was awarded by the Univ. of Rennes I foundation as the best PhD thesis in Math, Computer Sciences and Electrical Engineering. This award is dedicated for the PhDs having the highest potential for innovation and technological transfer
;ses-de-la-fondationhttps://fondation.univ-rennes1.fr/les-prix-de-thèses-de-la-fondation.

WHISPER Team

6.1. Highlights of the Year

The paper "Faults in Linux 2.6" was published in the ACM journal Transactions on Computer Systems in June 2014 . It has been downloaded from the ACM digital library almost 300 times since then. The paper was reviewed in the Linux Weekly News, in the German professional IT website golem.de, and was the subject of an invited presentation at a joint session of the Linux Kernel Summit and LinuxCon North America.

Julia Lawall was invited to the 2014 Linux Kernel Summit, an invitation-only meeting of core Linux developers. She was subsequently invited to participate in the plenary Linux Kernel Developer Panel at LinuxCon Europe, with 2000 attendees.

Julia Lawall was invited to give a keynote at the conference Modularity (formerly AOSD) on her work on Coccinelle [16].

BEST PAPERS AWARDS :

[] **ACM Transactions on Computer Systems**. N. PALIX, G. THOMAS, S. SAHA, C. CALVÈS, G. MULLER, J. L. LAWALL.

WILLOW Project-Team

6.1. Highlights of the Year

- J. Sivic started ERC project LEAP (2014-2018).
- J. Sivic serves as a Program Chair for International Conference on Computer Vision, Santiago, Chile, 2015

WIMMICS Project-Team

6.1. Highlights of the Year

BEST PAPERS AWARDS :

[52] **IEEE/WIC/ACM International Conference on Intelligent Agent Technology, IAT**. A. G. B. TETTAMANZI, C. DA COSTA PEREIRA.

[45] **10th IEEE International Conference Beyond Databases, Architectures, and Structures (BDAS 2014)**. T. H. H. NGUYEN, N. LE THANH.

ZENITH Project-Team

6.1. Highlights of the Year

- Patrick Valduriez received the 2014 Innovation Prize from Inria – Académie des sciences – Dassault Systems.

- Miguel Liroz-Gistau received the best presentation award from the Grid5000 Spring School 2014 in Lyon for his talk on "Using Grid5000 for MapReduce Experiments".

- Triton, a new common lab. (i-lab) has been created between Zenith and Beepeers (beepeers.com) to work on a platform for developing social networks in mobile/Web environments.

- 127 research groups worldwide registered to the LifeCLEF 2014 evaluation campaign chaired by Alexis Joly.