



RESEARCH CENTER
Sophia Antipolis - Méditerranée

FIELD

Activity Report 2014

Section Highlights of the Team

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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.

AOSTE Project-Team (section vide)

APICS Project-Team (section vide)

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 MICCAI 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.

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

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/>.

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 pyrenoidosa* [11].

CASTOR Project-Team (section vide)

COATI Project-Team (section vide)

COFFEE 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 Moot hosted on the FUN platform. This Moot is devoted to the study of the Python language, and targets undergrad 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 Moot 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 Moot see https://www.france-universite-numerique-moot.fr/courses/inria/41001/Trimestre_4_2014/about.

ECUADOR Project-Team (section vide)

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.

GALAAD2 Team (section vide)

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).

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

INDES Project-Team (section vide)

LAGADIC Project-Team (section vide)

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](http://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

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 Carnegie 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.

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.

MCTAO Project-Team (section vide)

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.

MORPHEME Project-Team

5.1. Highlights of the Year

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

NACHOS Project-Team (section vide)

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.

OPALE Project-Team

6.1. Highlights of the Year

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

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.

SCALE Team (section vide)

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.

TITANE Project-Team (section vide)

TOSCA Project-Team (section vide)

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 expertise gained by our groups on physical models of plant tissue development has been wrapped up in a review paper [12].

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.