



RESEARCH CENTER
Sophia Antipolis - Méditerranée

FIELD

Activity Report 2012

Section highlights of the Team

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ABS Project-Team

2.2. Highlights of the Year

Three key achievements were obtained in 2012.

The first one deals with the problem of modeling high resolution protein complexes, a topic for which we came up with an original binding patch model [14]. Our model not only provides more accurate descriptors of key quantities (the binding affinity in particular), but also sheds new light on the flexibility of proteins upon docking. These developments will in particular be used to investigate complexes from the immune system in the future.

The second one deals with the problem of modeling large protein assemblies, involving up to hundreds of polypeptide chains. We finalized the application of our Toleranced Models framework to the nuclear pore complex [13], [19], and started to produce novel algorithms for mass-spectrometry data [18], an emerging technique to infer structural information on large molecular machines.

Finally, we have also made a steady progress on algorithmic foundations, in particular on the problem of developing a Morse theory for point cloud data, in the perspective of analyzing molecular dynamics data. Tests are currently on the way, so that this work will be advertised in 2013.

AOSTE Project-Team

2.2. Highlights of the Year

Aoste underwent its periodical Inria evaluation, as part of the Real-Time Embedded theme, in its eighth year of existence. Evaluation was very positive.

APICS Project-Team (section vide)

ASCLEPIOS Project-Team

2.2. Highlights of the Year

- N. Ayache, H. Delingette, X. Pennec, M. Sermesant, G. Malandain, I. Strobant, A. Cortell were largely involved in the organization of the MICCAI 2012 conference (Medical Imaging Computing and Computer Assisted Interventions). The conference gathered together 1200 from more than 40 countries between October 1 to October 5, 2012 in Nice Acropolis.
- The ERC Advanced Grant MedYMA on Biophysical Modeling and Analysis of Dynamic Medical Images has started in April 2012 for a period of 5 years.
- **Stéphanie Marchesseau** received the Young Investigator award at the MICCAI 2012 conference held in Nice (Oct. 2012) for her paper [42].
- **Hervé Lombaert** won the MCV 2012 best paper award at the MICCAI workshop on Medical Computer Vision (Oct. 2012) for his paper [38].
- **Hervé Lombaert** has received a prize from the research fund of Québec FRQ (<http://www.frq.gouv.qc.ca>) as the "star research student" of the month January 2013 for his paper [] .

BEST PAPERS AWARDS :

[42] **Proceedings of Medical Image Computing and Computer Assisted Intervention 2012 (MICCAI)**. S. MARCHESSEAU, H. DELINGETTE, M. SERMESANT, K. RHODE, S. DUCKETT, C. ALDO. RINALDI, R. RAZAVI, N. AYACHE.

[38] **Medical Computer Vision (MCV'12) MICCAI workshop**. H. LOMBAERT, L. GRADY, X. PENNEC, J.-M. PEYRAT, N. AYACHE, F. CHERIET.

[] **IEEE Trans. on Medical Imaging**. H. LOMBAERT, J.-M. PEYRAT, P. CROISILLE, S. RAPACCHI, L. FANTON, F. CHERIET, P. CLARYSSE, I. MAGNIN, H. DELINGETTE, N. AYACHE.

ATHENA Project-Team (section vide)

AXIS Project-Team

2.2. Highlights of the Year

- Y. Lechevallier was scientific chair of the most important francophon conference in Knowledge Management and Extraction (EGC) in 2012 [39].
- Creation of the association **France Living Labs** (May): the french network of living labs (labelled by ENoLL) has decided with a majority in 2011 (after the 5th wave) to create an association due to their growing number in order to promote the French Living Labs and to facilitate user-driven open innovation at a national level. ICT Usage Lab (cf. section 6.1.8) is co-founder of France Living Labs with 20 other founders such as CNED, competitiveness clusters (Cap Digital, Image et reseaux), Lorraine Smart cities living Lab, Universcience, Urban Living Lab, etc. (cf. section 6.2.4). ICT Usage Lab is represented officially by B. Trousse (Inria) as permanent representative and A. Zarli (CSTB) as suppleant in the administration council.
- B. Trousse was elected President of France Living Labs.
- This year, AxIS experiments its Action-Research approach with more than ten workshops with citizen and/or professionals (in the context of three contracts TIC TAC, ELLIOT and ECOFAMILIES) and mainly for the two first steps of a living lab process - the co-creation and/or exploration steps. Such an experience was very fruitful to identify the main research problems in deploying a living lab process and in designing and evaluating user experience in order to support user behaviour changes (cf. section 5.5).
- The ACM SIGSOFT 2012 Impact Paper Award has been attributed to Th. Despeyroux and his co-authors for a paper published in 1989: “CENTAUR: the system” [72].

AYIN Team

2.2. Highlights of the Year

- Yuliya Tarabalka was recruited as Inria CR2 to the AYIN team in September 2012.
- Yuliya Tarabalka received Best Reviewer Award of Transactions on Geoscience and Remote Sensing in July 2012.
- A new book was published: *Zoltan Kato and Josiane Zerubia. Markov Random Fields in Image Segmentation. Collection Foundation and Trends in Signal Processing. Now editor, World Scientific, 168 pages, September 2012.*
- A patent on skin care was deposited in collaboration with Galderma and the Morpheme research team in November 2012.

BIOCORE Project-Team

2.2. Highlights of the Year

- A model was developed in order to determine how to mix resistant and sensitive plants to vector-borne plant pathogens in order to best protect the crop. The model includes a process that would allow for the resistance breakdown through adaptation of the virus population and the wintering of the virus in the environment. The best mixing rate was then proposed in order to either maximize the production over a 15 year period or prevent the resistance breakdown [16]. This work is done with Frédéric Fabre and Benoît Moury of INRA Avignon.
- Green Stars, Institute of Excellence for Decarbonated Energy, was created this year, supported by a *Projet d'Investissement d'Avenir* funding. Recent Biocore developments in microalgae modeling strongly support the Green Stars Institute: including the temperature effect [14], [28], representing fast time scales of photosynthesis [37], coupling with hydrodynamics [13], representing N₂ fixation [89], modeling metabolism of microalgae [67], modeling anaerobic digestion of microalgae [20], developing observers [21] [101] and optimal strategies to produce biomass [90], [109].

BEST PAPER AWARD :

[36] **10th Conference on Computational Methods in Systems Biology**. A. CARTA, M. CHAVES, J.-L. GOUZÉ.

CASTOR Team (section vide)

COFFEE Project-Team (section vide)

COPRIN Project-Team (section vide)

DEMAR Project-Team

2.2. Highlights of the Year

- David Andreu received the 1st Price 2012 of the FIEEC-OSEO on Applied Research, for his research and innovation transfer with Vivaltis company.

FOCUS Project-Team

2.2. Highlights of the Year

- Jacopo Mauro's PhD thesis, entitled "Constraints meet concurrency", has been awarded a price as the best dissertation for the two years 2010 and 2011 by the Italian Association for Logic Programming (GULP).

GALAAD Project-Team (section vide)

GEOMETRICA Project-Team

2.2. Highlights of the Year

- Creation of a new Inria research team called TITANE on geometric modeling of 3D environments. Creation expected in 2013.
- Best Paper Award for "The Simplex Tree: An Efficient Data Structure for General Simplicial Complexes" at ESA 2012.

GRAPHIK Project-Team

2.5. Highlights of the Year

- Organization of ECAI 2012 (European Conference on Artificial Intelligence), one of the major conferences in AI, together with the Coconut team at LIRMM (see Sect. 9.1).
- Several keynote talks at international conferences and workshops: RuleML 2012, Effost 2012, Datalog 2.0 2012, MPREF 2012 (see Sect. 9.1).
- Three new ANR projects: ASPIQ, PAGODA and Qualinca, the latter being coordinated by GraphIK (see Sect. 8.1). The three projects tackle different aspects of ontology-based data management, with our rule-based framework as the kernel formalism.

BEST PAPER AWARD :

[31] **RR'2012: International Conference on Web Reasoning and Rule Systems**. M. KÖNIG, M. LECLÈRE, M.-L. MUGNIER, M. THOMAZO.

INDES Project-Team (section vide)

LAGADIC Project-Team

2.2. Highlights of the Year

- Marie Babel and Alexandre Krupa have defended their HdR in June 2012 [10] and December 2012 [13] respectively.
- Our paper [38] related to visual servoing based on dense ultrasound images (see Section 6.4.1) has been selected as one of the three finalists for the Best Oral Presentation in the Hamlyn Symposium on Medical Robotics'2012.

LOGNET Team

2.2. Highlights of the Year

- The contrat Alcotra Interreg *myMed: a peer-to-peer programmable social network and cloud platform* 2010-2013 ends. LogNet was the head of this ambitious project. The project can be visited at the page <http://www.mymed.fr> Please have a try, see Fig 2 !



Figure 2. <http://www.mymed.fr>

- Four articles on myMed has been published in the newspaper “Nice Matin”
 - <http://www.nicematin.com/article/lapplication-myriviera-lancement-en-fevrier.689848.html>
 - <http://www.nicematin.com/papier/tout-sur-la-riviera%E2%80%A6-a-portee-de-doigt.831703.html>
 - <http://www.nicematin.com/derniere-minute/myriviera-bientot-sur-les-smartphones.831394.html>
 - See Fig 3 .
- A quite nice “artistic video” on myMed can be seen on www-sop.inria.fr/teams/lognet/multimedia/myMed_v3.mov. Please enjoy it!

nice-matin
Lundi 29 octobre 2012 5

CHÂTEAUNEUF-VILLEVIEILLE

Le Pays des Paillons aura son propre réseau social sur le web

D'abord, il y a eu la diffusion du guide des transports. Puis, un travail de terrain qui a permis de recenser environ soixante-dix points d'intérêts du Pays des Paillons. Maintenant, l'Association pour le développement du Pays des Paillons (ADPP) caresse un nouveau projet qui s'articulera autour des réseaux sociaux. Le conseil de développement vient de réunir, à Châteauneuf-villevieille, les maires des communes du Pays des Paillons, les membres du conseil de développement, les professionnels du tourisme. Geneviève Bach, vice-présidente de l'ADPP, et Nadine Broch, présidente du conseil de développement, ont présenté le projet.

MyMed est un réseau social transfrontalier, à coût zéro, élaboré dans le cadre du programme européen Alcotra qui favorise l'échange d'informations à partir d'un ordinateur ou d'un smartphone. Luigi Liquori, chef de file du projet et directeur de recherche à l'Inria, à Sophia Antipolis, a précisé que MyMed se proposait de conjuguer les fonctionnalités offertes par les réseaux sociaux classiques (Facebook, LinkedIn...) et les sites de partage (YouTube, Wikipédia...) aux besoins et particularités de la zone transfrontalière. Différentes applications composent ainsi MyMed, parmi lesquelles MyRiviera. M. Vani, ingénieur, a souligné que cette dernière communiquerait principalement sur des événements comme les manifestations sportives, concerts, festivals... Pour le maire Edmond Mari, « ce réseau social contribue notamment à valoriser les spécificités territoriales du Pays des Paillons, ses richesses patrimoniales et son dynamisme ».

Afin de concrétiser ce projet, des ateliers seront planifiés pour communiquer plus amplement sur ce réseau social.

NELLY PUJOL



Le maire Edmond Mari a accueilli les porteurs du projet MyMed.
(Photo N. P.)

Figure 3. Nice Matin

MAESTRO Project-Team

2.2. Highlights of the Year

- Eitan Altman has received the France Telecom Prize awarded by the French Academy of Sciences.

BEST PAPERS AWARDS :

[47] **8th International Wireless Communications and Mobile Computing Conference (IWCMC)**. K. AVRACHENKOV, P. GONÇALVES, A. LEGOUT, M. SOKOL.

[53] **6th International Conference on Performance Evaluation Methodologies and Tools (VALUE-TOOLS)**. N. CHOUNGMO FOFACK, P. NAIN, G. NEGLIA, D. TOWSLEY.

[58] **14èmes Rencontres Francophones sur les Aspects Algorithmiques des Télécommunications (Algo-Tel)**. F. V. FOMIN, F. GIROIRE, A. JEAN-MARIE, D. MAZAURIC, N. NISSE.

MARELLE Project-Team

2.2. Highlights of the Year

This year, the Mathematical Components project of the Microsoft Research-Inria joint center under the direction of Georges Gonthier completed the major objective it had set six years ago: the complete formal verification of the Odd Order theorem, also known as the Feit Thompson theorem, which states that every odd order finite group is solvable. The Marelle project-team is a key participant in this project.

For more information : <http://www.msr-inria.inria.fr/Projects/math-components/feit-thompson>

MASCOTTE Project-Team (section vide)

MCTAO Team

2.2. Highlights of the Year

- The team started this year.
- Bernard Bonnard publishes, with Dominique Sugny from University of Bourgogne, a reference book on control applications to Quantum Dynamics and Space Dynamics [18].

MODEMIC Project-Team

2.6. Highlights of the Year

- *The characterization of interconnections of chemostats that provide a global stability of bioprocesses with inhibition, mentioned in Section 6.1.1, has led to a patent application by INRA [59].*
- *Anaerobic membrane bioreactors (AnMBR) have a great potential for treating wastewater since they allow energy recovery (the biogas produced is mostly composed of methane) while guaranteeing a total separation of the treated water and of the microbial content of the process. However, their main drawback is the fouling of the membrane. In order to control the process while limiting the risk of clogging, we have developed a new model for AnMBR in coupling a two-step anaerobic model (called the “AM2” or the “AMOCO” model) with a model describing fouling dynamics [16].*
- *We have proposed hybrid models (deterministic/stochastic and continuous/discrete) of population dynamics as alternatives to conventional models based on ordinary differential equations. The later models are generally accepted as a good approximation of the former ones in large population asymptotic, but even in very large population size the two groups of models present drastically different behavior, notably in terms of persistence properties [15], see Section 6.1.5.*

MORPHEME Team

2.2. Highlights of the Year

- Laure Blanc Féraud has obtained the “grade de chevalier dans l’Ordre National du Mérite”.

NACHOS Project-Team (section vide)

NEUROMATHCOMP Project-Team

2.2. Highlights of the Year

1. **Organisation of the Workshop on Biological and Computer Vision Interfaces in Firenze October 12, 2012, held in conjunction with ECCV 2012.** This workshop was organised by Olivier Faugeras and Pierre Kornprobst. This workshop was a one-day event with prestigious invited speakers discussing several aspects of biological and computer vision interfaces, namely biological vision, mathematical and computational paradigms for biological and human vision, computational and hardware models of the visual brain and bio-inspired methods for computer vision. More information is available at <http://www-sop.inria.fr/manifestations/wbcvi2012/index.shtml>
2. **Organisation of the workshop NeuroComp/KEOpS'12, Bordeaux, 10-11 October 2012.** This workshop was jointly organized by F. Alexandre and T. Viéville (Mnemosyne), B. Cessac (Neuro-mathcomp), A. Palacios and M.J. Escobar (CN Valparaiso). It addressed the following issues (i) neural population dynamics and coding; (ii) architecture (and information flow) at the retinal and the brain level. The workshop was a two days event involving speakers in the field of vision and cognition, robotics, retina healthcare and prosthesis, and dynamical systems modeling. More information is available at <http://neurocomp.risc.cnrs.fr/neurocomp-2012/index.php?page=1>.
3. **European Union project "MATHEMACS" accepted.** The MATHEMACS project aims to develop a mathematical theory of complex multi-level systems and their dynamics. This is done through a general formulation based on the mathematical tools of information and dynamical systems theories. To ensure that the theoretical framework is at the same time practically applicable, three key application areas are represented within the project, namely neurobiology, human communication, and economics. These areas not only provide some of the best-known epitomes of complex multi-level systems, but also constitute a challenging test bed for validating the generality of the theory since they span a vast range of spatial and temporal scales. Furthermore, they have an important common aspect; namely, their complexity and self-organizational character is partly due to the anticipatory and predictive actions of their constituent units. The MATHEMACS project contends that the concepts of anticipation and prediction are particularly relevant for multi-level systems since they often involve different levels. Thus, as a further unique feature, the project includes the mathematical representation and modeling of anticipation in its agenda for understanding complex multi-level systems.
4. **European Union project "RENVISION" accepted.** RENVISION's goal is twofold: i) to achieve a comprehensive understanding of how the retina encodes visual information through the different cellular layers; ii) to use such insights to develop a retina-inspired computational approach to high-level computer vision tasks. By exploiting the integration of recent advances in high-resolution light microscopy, 3D imaging and high-density multielectrode array technologies, RENVISION will be in an unprecedented position to investigate pan-retinal signal processing at high spatiotemporal resolution, allowing simultaneous recording from the entire population of ganglion cells and functional imaging of inner retinal layers at near-cellular resolution, combined with 3D structural imaging of the whole inner retina. The combined analysis of these complex datasets will require the development of novel multimodal analysis methods. Resting on these neuroscientific and computational grounds, RENVISION will generate new knowledge on retinal processing. It will provide advanced pattern recognition and machine learning technologies to ICTs by shedding a new light on how the output of retinal processing (natural, modelled) solves complex vision tasks such as automated scene categorization and action recognition.

OASIS Project-Team

2.2. Highlights of the Year

Ludovic Henrio defended his HDR entitled: “Formal Models for Programming and Composing Correct Distributed Systems” in September 2012.

BEST PAPER AWARD :

[22] 8th International ICST Conference on Testbeds and Research Infrastructures for the Development of Networks and Communities, Tridentcom. F. HERMENIER, R. RICCI.

OPALE Project-Team

2.3. Highlights of the Year

Our activity in road traffic modeling is reinforced by the creation of the Associated Team ORESTE with UC Berkeley.

Our activity in pedestrian flow modeling is reinforced by the doctoral thesis of M. Mimault, started in October, and the enrollment of M. Twagorowska on a post-doctoral position.

PLANETE Project-Team

2.2. Highlights of the Year

- Our paper entitled “I know who you will meet this evening! Linking wireless devices using Wi-Fi probe requests,” got the Best Paper Award – Runner Up, in IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (IEEE WoWMoM 2012), San Francisco, California, USA.
- After several years of heavy involvement in the IETF activities in the transport and routing areas, four documents authored or co-authored by project-team members reached the RFC status in 2012.
 - RFC 6726 (“Standards Track”) is a revision of the RFC 3926 that specifies FLUTE, the application that enables the reliable transmission of multimedia files to a large set of receivers, typically portable devices (smartphones). Over the years FLUTE and the underlying transport protocol, ALC, became key components that are now part of all the wireless Internet standards. This revision benefits from the insight gained by the deployment and usage of these components since 2006.
 - RFC 6584 (“Standards Track”) explains how to use classic authentication and integrity schemes (i.e. group MAC and digital signatures) in the ALC and NORM reliable multicast protocols. All the applications built on top of them, FLUTE for instance, directly benefit from this service.
 - RFC 6816 (“Standards Track”) specifies how to use the LDPC-Staircase AL-FEC codes (that we previously specified in RFC 5170) in the context of FECFRAME, a framework that enables AL-FEC codes to be dynamically and flexibly inserted in communication stacks for improved robustness. The typical use-case is the reliable delivery of multimedia contents in streaming mode. Therefore this RFC 6816 enlarges the fields of application of our LDPC-Staircase codes, initially designed to address file delivery use-cases (e.g. with FLUTE/ALC), to the realtime transmission of contents in streaming mode.
 - RFC 6834 (“Experimental Track”) specifies a mechanism to enforce state consistency between LISP sites by using version numbers in LISP mappings. LISP (Locator/ID Separation Protocol) uses mappings and encapsulation to improve the scalability of Internet routing and data-centers. This RFC is an enabler for fast and scalable resiliency and mobility techniques in LISP but also for state consistency in complex LISP (e.g., large datacenters).

REVES Project-Team

2.2. Highlights of the Year

An image from the paper *Optimizing Environment Maps for Material Depiction* – by Emmanuelle Chapoulie and Adrien Bousseau – was selected to appear on the front cover of the 8 issues of the journal *Computer Graphics Forum* 2012.

Jorge Lopez Moreno was honored with the Outstanding Doctoral Thesis Award at Universidad de Zaragoza.

This year has been particularly productive for our group, with seven publications in the top journals of our field (ACM TOG, IEEE TVCG, CGF) [15], [20], [19], [14], [13], [17], [16]

SCIPORT Team (section vide)

STARS Team

2.2. Highlights of the Year

Stars designs cognitive vision systems for activity recognition based on sound software engineering paradigms.

This year, we have designed several novel algorithms for activity recognition systems. In particular, we have extended an efficient algorithm for detecting people in a static image based on a cascade of classifiers. We have also proposed a new algorithm for re-identification of people through a camera network. This algorithm outperforms state-of-the-art approaches on several benchmarking datasets (e.g. Ilids). We have realized a new algorithm for the recognition of short actions and validated also its performance on several benchmarking databases (e.g. ADL). We have improved a generic event recognition algorithm by handling event uncertainty at several processing levels. We have extended an original work on learning techniques such as data mining in large multimedia databases based on offline trajectory clustering. We have designed a generic controller algorithm, which is able to automatically tune the parameters of tracking algorithms.

We have also continued a large clinical trial with Nice Hospital to characterize the behaviour profile of Alzheimer patients compared to healthy older people.

We have organized a summer school which was held at Inria in October 2012, entitled "Human Activity and Vision Summer School", with many prestigious researchers (e.g. M. Shah).

TOSCA Project-Team (section vide)

VIRTUAL PLANTS Project-Team

2.2. Highlights of the Year

- **Move of the team to a new campus to join other Inria teams.** Until this year, the team was located at the Cirad Lavalette campus in Montpellier. In May 2012, it moved to the *Maison de la Modélisation pour le vivant et l'environnement* in Montpellier close to the campus of Computer Science research (LIRMM). This move is intended to strengthen the presence of Inria in Montpellier by gathering several Inria teams at the same place, fostering interactions between them and consequently augment the visibility of Inria in the region. It is also meant to support the creation of the *Computational Biology Institute of Montpellier*, IBC, that succeeded to the national call on *investissements d'avenir* of ANR, and in which both Zenith and Virtual Plants Inria teams are strongly involved.
- **Acceptation of the Inria Large Scale Initiative Morphogenetics.** The Inria *action d'envergure* Morphogenetics was evaluated by Inria and accepted. The project gathers 3 Inria teams (Imagine, Morpheme and Virtual Plants) from 2 Inria centers (Rhône-Alpes and Sophia-Antipolis-Méditerranée) and 2 Inria teams (RDP and RFD) from Lyon and Grenoble respectively to address the problem of flower development at early stages. The kick-off meeting of the project was held in November in Montpellier. The project will last 4 years and will focus in particular on the modelling of meristem mechanics during the early phases of organogenesis and how it is related to genes.
- **First paper on L-Py published.** The first paper describing our simulation system language *L-Py* has been published in *Frontiers in Plant Science*. The maturity and the diffusion of this software module increases and is now the basis of the work of several groups worldwide. Several training sessions have been organized by the team in the last two years and will be at the core of the future training program proposed by the Virtual Plants team on plant modeling.
- **Completion of a series of papers on tree development analysis using various types of stochastic processes.** Understanding tree development over several years has been the object of active research since about 10 years. This has generated the development of integrative models for analyzing tree growth components (ontogeny, climate and local environment influence) and patterns, in particular models combining latent state variables, tree response variables and environmental explanatory variables but also individual and population parameters [39] [2]. This approach has been applied to forest and fruit trees, to tropical and temperate species growing in various conditions (orchard, managed forest stand and unmanaged forest understory) [7] [49], [16].

WIMMICS Team

2.2. Highlights of the Year

Fabien Gandon was general co-chair of the most important academic conference about the Web: WWW 2012, Lyon.

Best poster award at ISWC 2012 for Serena Villata and Fabien Gandon, *Towards Licenses Compatibility and Composition in the Web of Data* [75].

Minister of Culture signed the Sematicpedia Convention with Inria and Wikimedia France thanks to the DBpedia.fr project we initiated.

Serena Villata was recruited on a research position at Inria.

Fabien Gandon was appointed Advisory Committee Representative of Inria at W3C

ZENITH Project-Team

2.2. Highlights of the Year

Patrick Valduriez has been elected ACM Fellow (2013).

At the 2012 competition of the Ontology Alignment Evaluation Initiative (<http://oei.ontologymatching.org>), our YAM++ ontology matching tool ranked first at the Large Biomedical Ontologies (largebio) track.

Members of the team have published the first textbook on P2P data management [9]. in the series Synthesis Lectures on Data Management by Morgan & Claypool Publishers.