Activity Report 2015

Section Highlights of the Team

ATEAMS Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

4.1.1. Awards

Prof.dr. Paul Klint won the IEEE TCSE Software Engineering Distinguished Service Award 2015. This award is presented "annually for outstanding and/or sustained contributions and service to the software engineering community".

BONSAI Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. MyNorine invents the crowd sourcing for Non Ribosomal Peptides

For ten years, the team has been developing a unique knowledge base, Norine, dedicated to the modeling and analysis of Nonribosomal peptides (NRPs). NRPs are secondary metabolites produced by bacteria and fungi that represent a huge source of natural products with applications in agricultural or health areas. In January 2015, we have released a new version which contains several major advances. MyNorine is a user-friendly service, that allows to submit new NRPs and to edit existing ones [2]. It was tested and validated by a panel of expert users during an international workshop that we organized in Lille in October, and that attracted 32 attendees from 8 countries. Moreover, s2m is an innovative tools to infer the monomeric structure of the peptides [1].

5.1.2. 1,000 white blood cell samples processed by Vidjil

Vidjil is an open-source platform for the analysis of high-throughput sequencing data from lymphocytes developed by the team. In October 2014, we opened a web server to grant everyone an access to Vidjil, our white blood cell analysis software used for leukemia diagnosis and follow-up. For one year, Vidjil analyzed more than 1,000 samples totalling 5 billion DNA sequences. Our users come from about thirty hospitals and labs throughout the world [3]. About fifteen of them regularly submit new samples. In Lille, the hematology department of the hospital uses Vidjil to identify malignant white blood cells at diagnosis on every patient with acute leukemia.

DEFROST Team

5. Highlights of the Year

5.1. Highlights of the Year

Inverse deformable model in real-time by quadratic programming optimization

We have published the formulation of an inverse deformable model that we can compute in real time in the form of quadratic problem under equality and inequality constraints. After the projection of the deformable model in the reduced space of unknown parameters, we get an extremely compact formulation of the problem to be optimized. The quadratic formulation allows to write the problem with the conditions Karush-Kuhn-Tucker (KKT) and thus have certainties about the uniqueness and optimality of a solution. This formulation was used in image registration project for adaptive radiotherapy (study published in the International journal of computer assisted radiology and surgery) and also to calculate the inverse model of a deformable robot (study published in the conference ICRA 2015).

Deformable robots with vertebras

We proposed a for generic modeling method suitable for manipulator arm composed of a successive series of deformable portion (inter-vertebrae) and rigid (vertebrae). This method is very computationally efficient and compatible with real-time. These manipulators have a very large number of degrees of freedom. Our approach is to make a domain decomposition from a FEM model on inter-vertebrae and pre-compute a condensation of the model on the vertebrae to drastically reduce the complexity of the model used online. Condensed models are assembled for the global model of the robot. We have demonstrated in an article published in the ICRA 2015 conference that this model allowed to pilot the flexible robot CBHA developed by Festo. Furthermore, we have used this model to propose a new manipulator arm design called FETCH to the competition website Robotic Toolkits Harvard University. We had the 2nd place ex-aequo with 4 other teams.

SOFA

The work we have done and published around our simulation platform SOFA allowed us to get the price "Dirk Bartz Prize for Visual Computing in Medicine 2015," a biennial competition organized by the Eurographics conference. This award recognizes the significant contributions in computer graphics have an impact in the field of medicine. Parallel to that price, a consortium was created to SOFA (https://www.sofa-framework.org/sofa-consortium/) whose objective is to bring the academic community and users of industrial SOFA and also of guide future developments. Defrost is a member of this consortium.

Eurographics Dirk Bartz Prize for Visual Computing in Medicine.

DOLPHIN Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

- Best paper award at GECCO 2015 (ECOM track, Madrid, Spain, 2015) for the paper "Global vs local search on multi-objective NK-landscapes: contrasting the impact of problem features" , by F. Daolio, A. Liefooghe, S. Verel, H. Aguirre, K. Tanaka. This work is part of our collaboration with Shinshu University in Japan (Associate team s3-bbo and JSPS-MEXT project) on fitness landscape analysis and search performance. In this paper, we consider two prototypical multi-objective optimization algorithms and relate their performance on combinatorial optimization problems with tunable ruggedness, objective space dimension, and objective correlation. Our study departs from simple performance comparison by systematically analyzing the correlation between runtime and problem features, contrasting their association with search performance within and across problem classes. A mixed-model approach allows us to further generalize from the experimental design, supporting a sound assessment of the joint impact of problem features on the search performance.

- Best paper award of "11th Intl. Conf. on Parallel Processing and Applied Mathematics" (PPAM'2015, Krakow, September 6-9). assigned to Jan Gmys, Mohand Mezmaz, Nouredine Melab and Daniel Tuyttens for their article entitled "IVM-based Work Stealing for Parallel Branch-and-Bound on GPU" . This work falls within the framework of the Ph.D thesis of Jan Gmys from University of Mons in cotutelle with Université Lille 1. The contribution consists in revisiting on GPU the parallel design and implementation (based on the Work Stealing paradigm) of the Branch-and-Bound algorithm applied to permutation problems. The raised challenge, which is the originality of the contribution, is to efficiently perform highly irregular exploration process entirely on the GPU having a SIMD architecture.

- Thesis Prize: 26th Nov 2015: Julie Jacques (Phd 2011) won the "Force Awards Nord de France" trophee in the category "thesis with an industrial". Her thesis work, in collaboration with the Dolphin team and the Alicante company, aimed at providing new datamining approaches in order to optimize inclusion in clinical trials.

BEST PAPERS AWARDS :

[31] **GECCO'15 - Proceedings of the 24th ACM Annual Conference on Genetic and Evolutionary Computation**. F. DAOLIO, A. LIEFOOGHE, S. VEREL, H. AGUIRRE, K. TANAKA.

[54] **11th Intl. Conf. on Parallel Processing and Applied Mathematics**. J. GMYS, M. MEZMAZ, N. MELAB, D. TUYTTENS.

4. Highlights of the Year

4.1. Highlights of the Year

2015 has been a good year in terms of journal publications for Dreampal, with 8 articles mostly in very high-quality venues.

FUN Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Inauguration of the FIT IoT Lab Lille's platform with its first robots open to the community.
- Full description of the TraxNet communication stack in the framework of our collaboration with TRAXENS, with real in situ experiments on the container ships Bougainville and America Vespucci. (3 pending patents)
- The FIT facility has been proposed as an "Infrastructure de Recherche" (Infrastructure for Research) by the CD TGIR.

5.1.1. *Awards*

The TRACAVERRE project has been nominated for the Prix de l'Innovation VINCI 2015.

INOCS Team (section vide)

LINKS Team

5. Highlights of the Year

5.1. Highlights of the Year

SheX

SHEX SCHEMAS FOR RDF GRAPHS IN COOPERATION WITH THE W3C

I. Boneva and S. Staworko present the RDF schema language SheX [22] in cooperation with members of the W3C. The usual open world approach of RDF is schemaless in the alphabets of RDF data are left open, so that data from different sources and with different alphabets can be unified. This raises serious problems for query writing and thus linked data integration, since the same query may become invalid when the alphabet changes. A SheX schema allows express constraints on the alphabets, node labels and edge labels of RDF graphs, so that databases queries become safe with respect to future changes, without that the alphabets need to be closed. This work is highly relevant for the future on data integration for RDF data based on schema mappings.

IJCAI

REASONABLE HIGHLY EXPRESSIVE QUERY LANGUAGES

In his IJCAI paper [17] P. Bourhis develops a highly expressive Web query language of the Datalog family, for which static analysis problems such as query containment remain decidable. The relevance of this result is explained to non-experts in a popularization article: http://www.cnrs.fr/ins2i/spip.php?article1465

5.1.1. Awards

This paper obtained the honorable mention of IJCAI .

IJCAI-highlight

LEARNING JOIN QUERIES FROM EXAMPLES

Ciucanu, A. Boneva, and S. Staworko published an article at ACM TODS [7], where they show how to learn join queries for relational databases from examples. The learning algorithm they provide is shown to satisfy Gold's learning model. Previously this model got applied only to inference of automata rather than logical queries. Furthermore, this is the first query learning algorithm that relies on equalities of data values rather than on the structure of metadata.

BEST PAPERS AWARDS :

[17] **IJCAI**. P. BOURHIS, M. KRÖTZSCH, S. RUDOLPH.

MAGNET Team

5. Highlights of the Year

5.1. Highlights of the Year

We have published two papers at NIPS [3], [6], the leading conference in machine learning. The first paper presents novel results on large-scale learning with higher-order risk functionals, which has applications in link prediction, graph inference and metric learning (among others). The second paper proposes new gossip algorithms for decentralized estimation of pairwise statistics in networks.

We have published a paper at AAAI [4], one of the top conferences in Artificial Intelligence. The contribution is a new structured model for learning anaphoricity detection and coreference resolution, which achieved the best score to date on the popular CoNLL benchmark with gold mentions.

We have published a paper at EMNLP [2], a leading conference in Natural Language Processing. The work presents a detailed comparative framework for assessing the usefulness of popular unsupervised word representations for identifying so-called implicit discourse relations.

<p align="center" style="color:red">MEPHYSTO Team</p>

5. Highlights of the Year

5.1. Highlights of the Year

Scientific results

The team obtained two striking results in 2015.

- In collaboration with Felix Otto, Antoine Gloria obtained near-optimal estimates with optimal stochastic integrability in stochastic homogenization under a finite range of dependence assumption, cf. [35].

- In collaboration with physicists at PhLAM, Stephan De Bièvre and Guillaume Dujardin, proposed in [18] an analysis of the phenomenon of modulational instability in an optic fiber, induced by periodic modulation of the dispersion of the fiber. In particular, they characterized the frequencies at which the gain occurs and provided sharp estimates of that gain. Both numerical and physical experiments supported the analysis, cf. Figure 2 which displays the experimental gain (above) and the numerical gain (below).
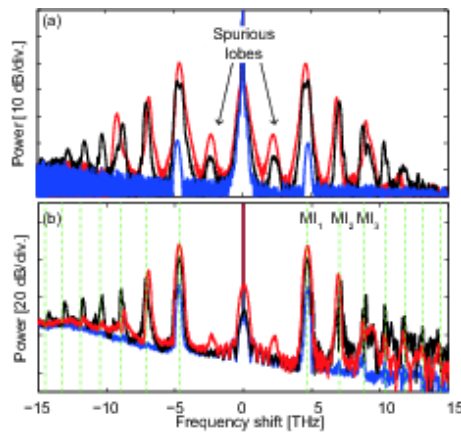

Figure 2. Experimental (above) and numerical (below) gain for the modulational instability in (periodic) optic fibers

Awards

Antoine Gloria was awarded the Agathon De Potter prize in mathematics from the Académie royale de Belgique.

<p style="text-align:center;color:red;font-weight:bold;">MINT Project-Team</p>

4. Highlights of the Year

4.1. Highlights of the Year

4.1.1. Art/Science collaborations

4.1.1.1. Art paper and art show at SIGGRAPH ASIA (Kobe): Tools for digital anamorphoses: using raycasting techniques for creation anamorphoses

Anamorphoses have been know for centuries, as distorted images needing to be seen in a mirror from a special point of view in order to see the non-distorted image. During Renaissance, they have been associated to mathematical techniques for drawing such pictures efficiently, on specific mirror shapes (in the case of cylindrical or conical mirrors). We can expect in the next years a strong interest in such type of images, because of the emergence of various contexts and physical supports for image visualisation (soft or de-formable screens, lightmapping, projection of images on dynamic objects, etc...). Solving the numerical problem of anamorphosis in the general case belongs to the same class of problems as when the trend is to control image deformation as long as image is seen projected on, or reflected by, a non-planar surface, which can be of arbitrary shape. In this work, we show how raycasting technique, well-known in the computer graphics community , can be used to provide an efficient general framework for such rendering. We describe an effective procedure for building general anamorphoses. A generalisation of the method leads to the conception of three-dimensional anamorphic sculptures, usable for 3D printing anamorphic objects. We exhibit , through several artworks, tangible and virtual examples.

http://hal.univ-lille3.fr/hal-01258727v1

4.1.1.2. Presented at VISAP (IEEE InfoViz artTrack): "A main levée" Art Installation

Developed in collaboration with MINT, the "A main levée" art installation by Pauline de Chalendar was presented at VISAP, IEEE Infoviz ArtTrack, in August 2016. This immersive installation allows for free hand drawing using a virtual-reality headset. From this artwork (also presented at Panorama 2015 exposition),

4.1.2. Industrial collaboration: Hap2u

A license agreement has been signed with Hap2u, a new start-up which aims at designing new interaction devices, based on our patent on tactile rendering. Hap2u will industrialise commercial products, based on our patents. The beginning of the commercial activity might start in 2016.

4.1.3. MAuVE project

MAuve is a 4 Meuros project (2016-2020), which subject is ICT-based tools for mediation and access to knowledge. L. Grisoni is leading this project, along with S. Bartholeyns (historian, Lille 3) and S. Chaumier (sociologist, Univ. Artois).

<div align="center">

Mjolnir Team

</div>

5. Highlights of the Year

5.1. Highlights of the Year

The team has strengthened its ties with leading research groups in Canada:

- Fanny Chevalier has been appointed at the rank of Assistant Professor (status only) by the Department of Computer Science of the University of Toronto.
- Stéphane Huot has been granted the "Collaborator" status by the Centre for Interdisciplinary Research in Music Media and Technology (CIRMMT) of McGill University.
- Mitacs/Inria research awards allowed two of our Phd students to visit the University of Waterloo and McGill University. A third Mitacs award with Campus France will allow one PhD student from Carleton University to visit us in early 2016.
- Two other PhD students and three researchers from McGill University, the University of Waterloo and the University of Toronto visited us over the year.

Fanny Chevalier spent a week with the French news website Rue89 in October and one of their journalists (Benoît Le Corre) later spent one week at Inria Lille. Four articles published on Rue89 resulted from these visits, with over 40,000 views at the time of this writing.

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

5. Highlights of the Year

5.1. Highlights of the Year

MODAL was implicated at the first level (general chair) in the organization of the main annual French conference in statistics gathering more than 400 participants (JdS 2015, see Section 10.1.1.1. General chair, scientific chair). It is the first time this conference is held in Lille since about 30 years.

MixtComp is the first package for clustering data with full mixed data (continuous, categorical, counting, ordinal, rank) with possibly missing or partially missing (intervals) data (see Section 6.15. MixtComp).

NON-A Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

- Concepts of Homogenenty, Implicit Lyapunov Functions and Convergence in Finite/Fixed time are now extended to different classes of dynamic systems (e.g time delay systems [27], distributed parameters systems [67], time-varying systems [42], MIMO systems[38], [25], differential inclusions [37], multi agent systems [19],[23]). In this context, ANR Project Finite4SOS (cordinator: Wilfrid Perruquetti) is accepted for 2015-2020. It is aimed at development of different tools for non-asymptotic control and estimation for System of Systems.

- Living sensor is a biological organism, which can be utilized as a sensor of some enveronmental characteristics. In collaboration with Aquatic Ecotoxicology (EA) team from CNRS Lab "Environnements et Paleoenvironnements Oceaniques et Continentaux", University of Bordeaux 1, we developed innovative methods for monitoring the water quality using oysters as biological sensors [16], [51], [15]. The project ANR WAQMOS (coordinator: Denis Efimov) is supported for 2015-2020. It is aimed at creation of novel oyster-based living sensors (including hardware and software development).

- We provided a novel solution for motion control of wheeled mobile robots with obstacle avoidance (for single robot [32], [32] and a formation of robots [60]).

- From september 2015, model-free control [84],[7] is applied to control the traffic on A25 (access ramp « La Chapelle-d'Armentières »), users and DiRN are satified with results (http://www.lavoixdunord.fr/region/feu-intelligent-de-l-a25-quel-bilan-quatre-mois-apres-ia11b49733n3187841).

Awards

- Prize of "ABB AWARD: Best application/case study paper", IFAC Safeprocess, Paris, 2015, see [80].

5. Highlights of the Year

5.1. Highlights of the Year

The research team RAPSODI was created on August 1, 2015.

A new nonlinear numerical method for solving possibly degenerate parabolic problems with gradient flow structure was proposed and analyzed by C. Cancès & C. Guichard in [35]. This method is second order accurate in space and preserves the variational structure of the continuous problem, ensuring by the way the decay of the physical entropy. Moreover, it is more robust with respect to strong anisotropy ratios than the method proposed in [15] that was only first order accurate in space.

RMOD Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Pharo 4.0 has been released in April 2015.
- Moose 5.1 has been released in June 2015.
- The Synectique company, a spin-off of the RMod group with two members actively participating, got selected on the i-Lab 2015 contest (category: Creation and Development). 364 projects were submitted in this category and 54 got selected (<15%). This will allow the young company to expand its activities by hiring young developers and a sales person.
- Papers published at PLDI and OOPSLA, two important conferences of our field.

5.1.1. Awards

- The paper : **First Analysis of String APIs: the Case of Pharo [36] got a price at IWST 15 International Workshop On Smalltalk Technologies.**
- **A paper of Martin Dias [25] was a candidate for best paper (part of the best 5) at SANER http://saner.soccerlab.polymtl.ca/doku.php?id=en:awards**
- **Markiyan Rizun got the third price at ESUG 2015 for his Rewrite tool.**

SEQUEL Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- organization of the 32nd International Conference on Machine Learning (ICML), in Lille, from Jul 6th to Jul 11th, 2015.

  ICML is the leading international conference in Machine Learning. This is the first time of its history that France hosts ICML. This edition has been the largest of all the times, with 1690 registrants (the previous record was 1400 in Beijing, in 2014).

- as an outcome of a contract with this start-up, Nuukik has been awarded "best data analysis" during the "connected commerce night" - http://www.retail-network.fr", 1500 participants, 80 projects in competition.

5.1.1. Awards

- V. Gabillon and B. Piot both received an AFIA award for their respective PhD, defended in 2014. They were both ranked second in this competition.
- Olivier Pietquin, Fellow of the "Institut Universitaire de France".
- A. Lazaric and M. Valko received best reviewer awards at ICML 2015.

SPIRALS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

In 2015, we are particularly proud that our project-team received four awards. We are all the more proud of the fact these awards have been granted to PhD students and to young engineers involved in transfer activities.

Clément Quinton received the Best thesis award from the CNRS GDR GPL (*Génie de la programmation et du logiciel*). Clément Quinton PhD thesis [82] proposes an innovative solution for configuring and deploying software systems on cloud computing environments with software product lines and ontologies. The work of Clément Quinton led to the implementation of the Saloon software system (see Section 6.3) and contributed to the FP7 PaaSage project (see Section 9.3).

Maria Gomez Lacruz received an award in the ACM Best Student Research Competition for her paper [26] at the ACM MobileSoft conference on mobile software engineering and systems. Maria Gomez Lacruz proposes a solution for detecting buggy applications with a recommendation system that learns from software available on mobile application stores.

Gérard Paligot received two awards at the STAF Transformation Tool Contest for his work on the Spoon (see Section 6.4) library for Java source code analysis and transformation. The two awards were in the categories Java refactoring, and Java annotation processing live, respectively.

Nicolas Petitprez received the Bpifrance award in the *Création d'entreprise innovante* contest in the category *Emergence*. This award is linked to the work of Nicolas Petitprez and Martin Monperrus towards the creation of the Makitoo start-up company that is planned to be launched in 2016. This transfer project is built around the Spoon (see Section 6.4) library for Java source code analysis and transformation.

BEST PAPERS AWARDS :

[26] **2nd ACM International Conference on Mobile Software Engineering and Systems**. M. GOMEZ, R. ROUVOY, M. MONPERRUS, L. SEINTURIER.