LaBRI
Laboratoire Bordelais de Recherche en Informatique
UMR 5800 du CNRS - Université Bordeaux 1
ENSEIRB MATHMECA - Université Bordeaux 2
Laboratoire associé à l’INRIA

REPORT
2005-2009
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Editorial

This report presents the scientific activity of the LaBRI, Laboratoire Bordelais de Recherche en Informatique (Bordeaux Computing Research Laboratory), a joint research unit (UMR 5800) associated with the CNRS and the University of Bordeaux (University Bordeaux 1, Bordeaux Polytechnic Institute and University Bordeaux 2) during the period from January 1 2005 to 31 August 2009. Created more than 20 years ago, the laboratory now includes more than 280 members of whom about a hundred are doctoral students. It is structured in six teams and shares nine projects with the INRIA Bordeaux-Southwest unit. The LaBRI is one of the participants, along with the Intégration du Matériaux au Système (Integration from Material to System) Laboratory and the Institut de Mathématiques de Bordeaux (Bordeaux mathematics Institute) in the Information Technologies Pole put forward as part of the accreditation of the Campus operation. Finally, the LaBRI is part of the Aerospace Valley and Route des Lasers (Laser Road) competitiveness poles and is a founder member of the Carnot Institute Matériaux et Systèmes de Bordeaux (Bordeaux Materials and Systems) (MIB).

The laboratory’s research themes cover a wide spectrum of computing and include both fundamental and applied aspects. This diversity is one of the laboratory’s strengths because it encourages leading edge research and interactions between research themes within the computing discipline. It is also an advantage in attracting researchers and teacher/researchers as is shown by the laboratory’s recruitments. Finally it allows the emergence of new projects and research themes advanced by young researchers.

The laboratory includes almost all the computing researchers and teacher/researchers on the Bordeaux site. Its staff are responsible for computing teaching to around 1900 students. Our students have no problems in entering employment, of which we are proud. Some of our former students decide to enter research, either as engineers or as doctoral students, because our teacher members present the laboratory to their students. We are persuaded that the unity and visibility of the laboratory are favoured by this commitment and that the work of all those who from day to day ensure that these students receive the best education possible, in particular the numerous stream directors, is an advantage for all the laboratory.

The LaBRI is also involved in the administration of the Bordeaux academic establishments at all levels. Amongst our members we have two university vice-presidents, a deputy director of the Bordeaux Polytechnic Institute and an IUT director.

Finally our laboratory is not well supplied with administrative and technical staff but its progress is made possible by the constant investment of these staff in the functioning of the laboratory. We wish here to pay tribute to their efficiency and professionalism.

The LaBRI, with the support of the establishments of the PRES University of Bordeaux, of the CNRS and of the Aquitaine Regional Council, has always had the desire and the ambition to bring together the whole Bordeaux computing research community. The rise in influence of our new partner the INRIA has contributed to this development by bringing in a large number of researchers through joint LaBRI-INRIA projects. In the years to come, in constant cooperation with all these actors, we must continue to unite the forces present so as to give an ever greater visibility and attractiveness to the Bordeaux site.

The following pages will describe the laboratory’s record and future plans, overall and at the level of each team. We hope that the reader will see, through these pages, the energy which drives the LaBRI and its members’ commitment to a harmonious development of our discipline and community.

We cannot finish this editorial without giving our opinion on two important points. Firstly, the excess work required for evaluations. Some of our colleagues this year will experience several evaluations : LaBRI, INRIA Bordeaux South-West, INRIA theme sector, ANR contract mid-term or final. Each evaluation, of course, requires a different format. In this way we arrive at a situation where researchers devote more of their time to being evaluated and justifying completed actions...
than to carrying out the work of research and supervision which is the heart of their mission. Would it not be simpler and less time consuming to increase recurrent credits so as to reduce project evaluations? \(^2\) to group multi-organism evaluations to increase efficiency? We are far from being opposed to the principle of evaluation. We work for and thanks to the public power and it is legitimate that we should have to account for our activities to the citizens. It should however be taken into account that the current system of evaluations considerably surprises French industry leaders (who are also citizens... ) and our foreign colleagues.

Moreover, we are convinced that the evaluation of scientific activity cannot be reduced to assessing the number of articles published or even the reputation of the journals and conferences where they appear. Scientific activity is measured in the long term and many decades may be necessary to know which results have marked our discipline. It is considering our colleague evaluators and to simplify their task that we have made the counts, as accurately as possible, presented in this report.

Maylis Delest  
Director of the LaBRI

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2. that is to favour a *posteriori* evaluation.
Overview of the Lab

1.1 General presentation of the laboratory

1.1.1 Overview of the laboratory

The LaBRI (Laboratoire Bordelais de Recherche en Informatique) is a mixed research unit (UMR 5800) associated with the CNRS, at the University of Bordeaux 1 Science Technology, the Institut Polytechnique de Bordeaux (Bordeaux Polytechnic Institute) (École Nationale Supérieure d’Electronique, Informatique et Radiocommunications de Bordeaux) and the University of Bordeaux 2 Victor Segalen. The LaBRI includes almost all the computer scientists of the Bordeaux site: CNRS researchers, INRIA researchers, teacher/researchers of the associated universities and also those of the University Montesquieu Bordeaux 4 (Law, social and political sciences, economics and management), that is 135 permanent researchers. Officially created in 1986, it is now linked with the “Institut des Sciences et Technologies de l’Information et de l’Ingénierie” (ST2I) of the CNRS and secondarily with the “Institut des sciences mathématiques et de leurs interactions (INSMI)”. At the level of the national committee, the main attachment is to section 7 with secondary attachment to sections 1, 22 and 34.

Because of the diversity of its research themes, in the course of the quadrennium, the LaBRI was secondarily attached to the MPPU (Mathematics, Physics, Planet and Universe) department and also to the “Cellular and molecular biology” and “Human and social sciences” discipline groups. The LaBRI became a partner, in 2002, of the INRIA “Futurs” unit and, from its creation in 2007, the INRIA Bordeaux Southwest Unit with which the laboratory shares 9 project-teams (including 2 in common with the Bordeaux Institute of Mathematics). The LaBRI is one of the founders of the Carnot “MIB” institute recognised in 2007 by the ANR. It is a member of the competitiveness poles “Aerospace Valley” and “Laser Road” as well as the Materials GIS.

1.1.2 Research structure

At the beginning of this contract, the LaBRI passed from from 5 to 6 teams which constitute the laboratory and very widely cover the fields of Computing research. The list of the teams is as follows:

- Combinatorics and Algorithms (CA)
- Image and Sound (IS)
- Languages, Systems and Networks (LSR)
- Formal Methods (MF)
- Models and algorithms for Bioinformatics and Information Visualisation (MABioVis)
- Supports and AlgoriThms for High Performance Numerical Applications (SATANAS).

This structure is complemented by numerous collaborations between teams and regularly gives rise to the emergence of transverse projects. A very full programme of working groups encourages these collaborations. They number a dozen and there are also a general seminar and a doctoral students' seminar. The most fruitful collaborations have produced new research themes. The Bioinformatic and Information Visualisation which constitute the MABioVis team created for this quadrennium are the result of this kind of effect. Two transverse projects are currently identified:

- the Visidia project: modelling and visualisation in distributed computing which concerns “Combinatorics and Algorithms” and “Formal Methods”;
- The Simbals project: text algorithms and sound modelling which concerns “Image and Sound” and “Models and algorithms for Bioinformatics and Information Visualisation”.

Joint projects with INRIA are being developed within each team. The areas of interest of the INRIA teams do not always correspond exactly to those of the teams’ themes. There are two sorts of reason for this: some researchers wish to work on themes wider than those of the INRIA
project teams and researchers publish in a theme close to the project team but distinct from it. The INRIA teams currently number nine:

- Cepage : Research in Large scale Platforms (CA)
- Gravite : Graph Visualisation and Interactive Exploration (MABioVis)
- Iparla : Visualisation and Manipulation of Complex Objects on Communicating Mobile Terminals (IS)
- Magnome : Genome Models and Algorithms (MABioVis)
- Phoenix : Design of Adaptive Programmes and Systems (LSR)
- RealOpt : (joint with IMB) : Reformulations and Algorithms for Combinatorial Optimisation (CA)
- Runtime : High Performance Executive Supports for Parallel Architectures (SATANAS)
- Scalapplix (joint with IMB) : Two joint project teams with INRIA are being created as a result of this project : BACCHUS (Intensive computation tools for numerical algorithms and resolution of hyperbolic problems) and HiePACS (Highly parallel algorithms for boundary digital simulation)
- Signes (including some teacher/researchers from the University Montaigne not associated with the LaBRI) : linguistic signs, grammar and sense : algorithmic logic of language (MF)

The transversal project Simbals whose theme is the analysis of music intends to enter discussions with INRIA. The LaBRI is a partner in SCRIME (Studio for Creation and Research in Computing and Electroacoustic Music) and in CBIB (Bordeaux Bioinformatics Centre).

1.1.3 Notable achievements

In this paragraph we list various notable achievements of the laboratory during this quadrennium. Firstly a number of nominations and distinctions have occurred. Two professors have received the title of Honorary Doctor of the University Bordeaux 1 on the LaBRI’s initiative : D.E. Knuth (Stanford) in 2007 and J. Nešetřil (Charles University, Prague) in 2009. Y. Métivier has seen his idea of “doctorant-conseil” in industry from the preceding quadrennium taken up and developed by the Ministry. M. Bousquet-Mélou has received the Charles-Louis de Saulses de Freycinet prize for 2009 from the Academy of Sciences. M. Kanté has received the Bordeaux University thesis prize. An experimental corpus of 23 annotated videos has been the object of an international use agreement with the University of North Carolina at Chapel Hill. A group of doctoral students from the Image and Visualisation theme won a prize in the IEEE VAST’2009 competition. Certain colleagues have been invited speakers at first rank conferences, for example STACS, FPSAC, EUROCOMB, PDCS, ICALP. Many best paper prizes have been won (CBMI’07, Eurographics, 3D Symposium on User interfaces, STOC for example).

In the domain of technology transfer, a company has been created as a result of the LaBRI’s work with the support of INRIA : Siderion technologies develops applicative telephone solutions. In 2009, O. Ly was a prize winner in the Oseo-Anvar competition in the emergence category in connection with the Rhoban robot project.

We note three major events for the LaBRI doctoral programme:

- In 2005, Daniel Gonçalves resolved a long standing conjecture (Chartrand, Geller and Hedetnimi 1971) stating that any planar graph is edge partitionable into two outerplanar graphs.
- In 2007, 4 LaBRI Ph.D. graduates joined the CNRS as “chargé de recherche” out of 25 positions available in section 7.

In the field of publishing, two books have had a certain success. One A. Zvonkin’s Mathematics for the very little was short listed for the best education and popularisation book prize in Moscow. The other is P. Casteran and Y. Bertot’s work Interactive Theorem Proving and Program Development on the language COQ, which has been translated into Chinese. The dynamism of LaBRI members has allowed the LaBRI to attract some major conferences. We have thus hosted 5 national conferences, 2 schools and renowned international conferences : CBMI’07, DAFX’07, DISC’08, STACS’08, VRST’08, ESSLLI’09, EUROCOMB’09. In total 2300 people have attended.
these conferences in two and a half years. In 2010 two major conferences will be organised: ICALP et EuroVis.

1.1.4 Partnerships

Successive LaBRI management teams have built up the Bordeaux computing laboratory with the support of the University Bordeaux 1, the ENSEIRB and the CNRS. This has allowed a continuing dynamism in recruitment and an ability to produce new themes since new streams created by laboratory members have, in return, enabled new teacher/researcher posts and led to a regional reputation. From this dynamism flow numerous and varied research operations within the university and with other partners. We describe below the actions carried out.

Partnership with laboratories in the University of Bordeaux

Historically the first partnerships were formed with the section “Applied Mathematics” of the IMB concerning intensive computation. During the current quadrennium, projects with other laboratories have come into being, notably with the Institute of Materials and Systems (one of the three laboratories of the “Technology of Information” pole): embedded systems and communicating objects (LSR), Video-surveillance (IS). In this last project, the “Epidemiology, Public Health, Development” research centre (INSERM Unit U897) is experimenting with embedded cameras to assist keeping Alzheimer’s sufferers at home. Other projects concerning image processing are in course with Bordeaux laboratories:

- Matching bronchial trees with the Physiopathology of Bronchial and Vascular Reactivity research centre (INSERM Unit U885)
- Modeling movement in IRM sequences with the Molecular and Functional Imagery laboratory (CNRS Unit UMR 5231)
- Terahertz Imagery undertaken with the Optical and Hertzian Molecular Physics Centre (CNRS Unit UMR 5798).

Partnership with INRIA

It may be thought that the visibility of the LaBRI and notably its ability to restructure itself were determinant in the decision to install INRIA in Bordeaux. An agreement protocol between INRIA and the Bordeaux PRES has been signed and covers the period from January 2008 until December 2010. This protocol defines the way for collaboration between the organisations and provides the framework for creating joint projects. Since this agreement, the LaBRI is called an “INRIA associated laboratory”. This association depends on the fact that a significant part of the laboratory is involved in the joint projects. A concertation committee is provided for by this protocol. It consists of the INRIA president-director general and the Bordeaux PRES president who can include the experts that they require. It met for the first time on 14 May 2009. For a closer supervision of developments, a local committee at the university of Bordeaux has met monthly since September 2009. It consists of representatives of INRIA Bordeaux-Southwest, of the universities and schools and also the directors of the laboratories. Since 2006 three joint projects have been officially created. It is to be noted that during the period 6 joint projects out of 9 have been led by LaBRI professors. The last teams created, like the previous ones, have arisen from research activities undertaken within the LaBRI and then recognised by INRIA. The LaBRI has strongly supported these joint projects, notably by assigning, since 2005, two permanent research engineer posts and 12 teacher/researcher posts (out of 30 provided). Currently 31% of the laboratory’s total research staff (measured in ETP: equivalent full time), excluding INRIA staff, are engaged in joint projects. The figure 1.1 shows the number of research ETP devoted to the joint projects since 2005 including for the most recent projects their gestation period. In these numbers, we have not counted the members associated with the teams who are harder to identify.
CHAPTER 1. OVERVIEW OF THE LAB

International Partnerships

The LaBRI has been host to 86 foreign researchers during this contract. Figures 1.2, 1.3 give an overview of the geographic cover of the LaBRI’s relationships. Twelve LaBRI members have made foreign visits of more than two months.

Participation in competitiveness poles

The LaBRI teams are involved in many projects within two competitiveness poles. The Aerospace Valley pole concerns aeronautics, space and embedded systems. The LaBRI in partnership with INRIA-Southwest participates in the SOUL, MACAO and SOLSTICE projects which have been recognised by the Aerospace Valley pole. Very recently in July 2009, the SYMM project concerned with the development of drones has received this recognition by the pole. This project involves the regional society Fly’n’sens and the IMS and LaBRI laboratories. It is a good illustration of the University of Bordeaux TI pole.

The “Laser road” pole concerns optics and its applications. Two projects involving the LaBRI have received recognition by this pole. They are the TeraBook project undertaken in collaboration with the I2S society and the CPMOH laboratory concerning the study of Terahertz technologies for document digitisation, and the Polinum project whose aim is the development of factory/laboratory for the digitisation of old documents. The process is under way to obtain FEDER financing for this last project.

Participation in national actions

LaBRI researchers also participate in the national thematic networks: GDR ALP (Scientific Committee), GDR Génolevures, GDR IM, GDR ISIS (Scientific Comittee), GDR Jeux, STIC SANTE, GDR GPL. The Génolevures platform, hosted by the LaBRI, has become a globally accessed resource. It is supported by the CNRS SDV department. Two French and one Belgian academician actively support its development.
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Figure 1.2 – International relations
Figure 1.3 – European relations
1.1.5 Situation in comparison with the objectives of the present quadrennium

The situation in comparison with the scientific objectives is discussed in the chapters devoted to the teams. We present here only the realisation of the objectives of the laboratory as a whole. One point emphasised was the development of industrial relations. We have organised a series of industrial meetings proposing a panorama of the teams’ abilities. Moreover our partnership with Thales has been reinforced, relying on the MF and LSR teams, and in 2010 this will lead to the creation of a joint Thales-University Bordeaux 1 laboratory. Finally contracts have been signed with local small enterprises. In 2010 an operation associating the LaBRI and the society I2S will start with, as its principal theme, digital image processing. A significant effort has been made to make the software developed in the LaBRI accessible. This software represents an important part of the work of the research teams. Two actions have been undertaken: allocation of Engineer manpower through the Carnot or permanent engineers, and depositing software through the APP, with 9 deposits in course. Among this software is:

- Alta-Rica: verification software which has become effectively a standard for aeronautical verification notably through its inclusion in Dassault’s OCAS software.
- NEKO 3D: 3D extraction of bronchial trees from X-ray lung scanner images.
- Tulip: one of the leading systems for manipulation of large graphs which is included in the Debian distribution and also runs on Windows and Macs.

At the level of hardware, an important development was the deployment of the GRID 5000 node. This was made possible by the creation of two new machine rooms in the LaBRI in 2006 and 2007 with national, regional INRIA and CNRS funds. A new activity concerning peer-to-peer networks has arisen around this node and has become the subject of a joint LaBRI-INRIA project CEPAGE. It is to be noted that the creation of these rooms has in return allowed us to speed up the hardware operations necessary for digital image processing and video indexing.

With respect to doctoral training, a widening of the modes of finance was envisaged, including notably a complete halt to unfinanced doctorates. The figure 1.4 shows the division of the sources of finance of doctoral students who have started their thesis since 2004. In addition the AFoDIB (Association of the Bordeaux Computing Doctoral School) has continued to organise regular doctoral student-enterprise meetings which have now been widened to the PRES with the AquiDoc forum.

Concerning the development of the Intranet envisaged in the project, while it has not been completed, it has advanced: event management, room reservations, travel arrangements, contract archiving. All publications have been migrated from the Basilic software to HAL as shown by this report. Following personnel changes within the system team, the development of the Intranet was suspended in September 2007 but should continue from October 2009. The level of administrative and technical staff remains a source of concern. It is well below the growth of the laboratory, even though the post of unit manager requested in the previous quadrennium has been allocated by the University Bordeaux 1.
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1.1.6 Personnel

As of 31 August 2009, the LaBRI numbered 105 teacher/researchers, 30 researchers (17 CNRS and 13 INRIA), 12 technical staff (7 CNRS, 4 University of Bordeaux 1 and 1 ENSEIRB) and 7.5 administrative staff (3 CNRS, 3 University Bordeaux 1 and 1.5 INRIA). In the course of the preceding quadrennium as in the current one, the laboratory’s growth in teaching/research and research personnel is around 30%. Figure 1.5 shows the division of ages of the laboratory members. It can be seen that the laboratory members are, on the whole, young and that there may be reason for concern over the ratio of supervision.

Teaching/research and research personnel

The LaBRI has always practised a policy of recruitment open to the outside. In the course of the period, out of 42 posts, 32 have gone to candidates from outside the laboratory. For assistant-professors and professors, the external recruitment has been:
- 6 candidates recruited out of 7 professor posts open to competition,
- 14 candidates recruited out of 20 assistant-professor posts open to competition.

This policy allows the LaBRI to be attractive to the best candidates, to renew itself by bringing new competences to the teams. This is done while striking a balance between the teams. Also, the job descriptions often imposed by the authorities associating two or even three LaBRI teams,
allow the posts to be attractive for many candidates. The new organisation of research in 6 teams has allowed a better assistance to themes which had small numbers in the previous quadrennium. In this way, without harm to the “historic” teams and thanks to INRIA and CNRS recruitment, the new teams have seen their numbers grow.

Administrative and technical personnel

The recruitment policy here is also widely open to the exterior. All the contract posts have been filled after a call for candidates, notably at the level of the ANPE or the APEC. A selection committee including members from outside the LaBRI has been constituted for each post. The real new positions allocated to the LaBRI are:

- Ingenior unit manager in 2006 (University Bordeaux 1),
- Budget technical assistant in 2007 (CNRS, open competition at the french level, the successful candidate had already a non permanent contract payed by ENSEIRB).

The other permanent posts filled during the quadrennium were:

- Budget technical assistant in 2008 (University Bordeaux 1) : this post existed in the LaBRI in 2005 and had disappeared as a result of an internal movement,
- Budget assistant ingenior to be filled in december 2009 (University Bordeaux 1) : this post is provided in anticipation of the retirement a permanent personnel.

The support provided by the ENSEIRB has taken the form of one technical assistant turned to technician in 2008, to a contract technician. This post is allocated half time to the organisation of conferences at the LaBRI and allows assistance to researchers in budget planning, registrations, planning ans practical things as coffee breaks or lunches. To allow a reasonable functioning, the management has taken the step of recruiting 3.5 ‘helped contracts paid from laboratory funds so that the administrative cell can cope with the volume of operations as well as the reception office. Concerning technical staff, a post of ingénior was provided as Noemi in 2006. In 2007, the person in charge of the systems and networks team wished to be seconded to INRIA. As a result of various transfers, the team has remained at the staffing level of 2006. As for research engineers supporting the teams, a 3 year long term contract post was provided by the CNRS in 2009. This post is currently allocated to the Visidia project and from 2010 it will be allocated half time to digital image processing. From the above, it is clear that the level of permanent administrative and technical staff has remained virtually constant for a decade. This situation makes the functioning of the laboratory more and more problematic. To prevent the situation from becoming chaotic, the laboratory has provided two non-permanent posts of team assistant from its own funds since October 2009, gambling that an improvement must come from our authorities.

Personnel training

During the period from 2005 to the end of June 2009, the total of training sessions followed by all laboratory staff was 3436 hours, in very strong progression since 2007. This reflects the wish of the laboratory management as well as our governing authorities to allow access by a wide public to a complete range of training opportunities. The fact that the administrative service includes a large proportion of contract staff (5 compared with 11 permanent) makes it necessary to devise individual training programs. This also explains the increase in the number of hours of training undertaken by these employees since 2007. The most commonly undertaken categories of training are english, use of administrative and technical tools, and hygiene and security.

1.1.7 Formation

Initial training

Doctoral training

The size of the laboratory, the diverse sources of funding and the LMD reforms have led the laboratory to put in place a doctoral training policy going from the assembly of thesis topics to
recruitment, installation and supervision of doctoral students. We give below an outline of this
policy. The local doctoral school centralises the offers of thesis topics which are approved and
ranked by the Scientific Committee of the laboratory and it uses this list for the various sources of
funding (ministerial allocations, BDI, etc.). This allows the laboratory to be more effective in two
ways: the number of allocations and the attractiveness of the laboratory by means of publication
aimed at candidates from December. In order to maintain the excellence of the quality of its
doctoral training, the laboratory has put in place a system of approval of all thesis candidates before
their administrative enrolment. For Ministerial and Regional funding, the laboratory relies on the
Scientific Committee to approve the candidates. Every doctoral student has his personal work
station, often prepared before his installation in the laboratory. Apart from teams accommodated
by the INRIA unit, the doctoral students’ offices are spread out over several places in the building
to allow a total integration of the students. A doctoral student introduction day takes place
in October. The laboratory encourages the students to take an active part in the teams’ work
groups as well as the laboratory seminar. In addition, there is a seminar run by the students for
themselves. Since 2006, has put in place, with the Maths-Computer Science doctoral school, the
doctoral student’s progress report. A survey of ex-doctoral students has been undertaken despite
very restricted secretarial resources. Over 86 PHD students, 6 became researcher, 20 became
assistant-professor and 27 are on post-doctoral position (19 in a foreign country). This survey is
one of the difficult problems which lead us to request, in the short term, a strengthening of our
secretarial resources since the laboratory accommodates, on average, 130 doctoral students. Finally,
the laboratory supports AFoDIB (Association of the Bordeaux Computing Doctoral School) by
providing it with an office and financial and administrative assistance for the events it organises.

1.1.8 Scientific production and contract activity

The quantitative record of LaBRI members’ publications if the period 2005 to 2006 is given
in the table 1.2.1 anda the list of these publications is given in the report on each team (with a
reference to inter-team publications).

As suggested by the recent report on the evaluation of researchers and teacher/researchers
by the academy in July 2009, the use of bibliometry is necessary but must remain a simple
aid to qualitative evaluation. Thus it is preferable to give several indicators. We have chosen to
represent the publications by a graph (number of publications/publishing members) containing
several possible indicators.

We note that the global number of publications per ETPC is not, from our point of view, a
good indicator. It penalises the older (or historic) teams which necessarily have greater numbers
of less active researchers. If it must be calculated, the average number of publications per ETPC
is 16.9.

Rank A selection and publications It is important to recall here the definition of a rank A
publication according to AERES: it may be
– an international journal with selection committee
– an internationally recognised research book chapter or book; or
– an international patent; or
– constituting an accessible data base or reference corpus; or
– a long article in an international conference considered as selective by the community.

According to this definition, the immense majority of the publications included in the categories
Journals and Conferences and Books are of rank A, it would be necessary to exclude only few of
them with a more restricted audience. On the other hand, our classifications Journals, Conferences
and Books correspond respectively to ACL, INV, ACTI, ACTN and OS, OV.

In addition we asked each team to define a selection of journals and conferences according to
criteria appropriate for its field. We hope thereby to help the evaluators to form a clear picture of
the activity of each team. This selection must not of course be interpreted as a distinction between
rank A and other publications: in each case the publications are of rank A and the experts can
also see this by consulting the lists of journals and conferences selected by each team.
Comparison with the previous quadrennium  The number of publications has risen very strongly: while the laboratory grew from 112 to 135 permanent staff members, the number of journal publications grew from 172 to 460 (of which 216 were in the teams’ selections). The number of invited conference papers grew from 49 to 66 and the number of books from 38 to 49. Given the more moderate increase in the laboratory’s staff numbers, it seems to us to be important to underline this quantitative leap.

Cohesion and insertion  Other figures show the laboratory’s cohesion and the significance of its insertion in the national and international scientific community. The table 1.2.3 shows the importance of co-publication between teams within our laboratory: 90 publications are inter-team. This very positive figure shows the LaBRI’s dynamism and the fruit of a policy, followed for a long time, of favorising internal collaboration and the emergence of new research areas. The effect of the Visidia (CA/MF) projects is visible, as also the collaboration between bio-informatics and sound on the one hand and visualisation and Image (IS/MABioVis) on the other, x1 and collaboration concerning embedded software security (LSR/MF). The SATANAS team similarly has a co-publication activity, mostly with the IMB with which it shares the EPI, for which reason it does not appear in this table.

The table 1.2.2 shows the number of LaBRI publications which have involved at least one co-author from outside the laboratory. These publications are very numerous for all teams amounting to 60% of total laboratory publications. These figures show the laboratory’s insertion in the national and international community and are influenced by national (ANR, joint EPIs with other Bordeaux laboratories on the part of SATANAS, MABioVis, CA and MF teams) and international projects.

1.1.9  Industrial relations

Since 2000, the LaBRI has had a valorisation unit called LaBRI-Transfert. This unit has largely contributed to the development of the LaBRI’s industrial relations, by assisting and helping in mounting ANR or industrial projects, by taking positive steps with industry, by organising research/industry meetings, by participating in various salons and by establishing communication structures. Finally, it has had a notable activity in making LaBRI researchers conscious of the possibility of registering their software.

The LaBRI’s activities in industrial relations range from very small enterprises (1 to 2 staff) to important groups such as Thales, Peugeot, Orange, etc. If the range of industrial relations is large, it should be noted that the contractual nature of these relations is also very varied. It ranges from the involvement of industrials in national (ANR) or European (IP) funding bids or projects recognised by the competitiveness poles to bilateral LaBRI/industrial research contracts including also industrial transfer projects supported by the Aquitaine region.

On average over the last four years, not taking into account ANR funding, the contractual activity of the LaBRI with industrials is of the order of 300 K€ per year covering a total of 25 projects (R&D contracts, training, provision of expertise). It may be noted that this figure has increased significantly in 2007, almost doubling. Nevertheless this figure may appear low for a laboratory of the size of the LaBRI, for which there are number of explanations.

A first explanation is connected to ANR funding. A large part of the laboratory personnel has moved into ANR projects. Precisely, the financial resources connected to ANR projects have grown from 480 K€ to 1280 K€ in 3 years. However it should be remembered that on average one ANR project out of 4.5 in the LaBRI involves industrial partners. These elements indicate that the industrial transfer and collaboration activities have increased.

A second explanation is linked to the LaBRI’s restricted involvement with medium term projects with large groups. Currently the LaBRI is not involved in any joint laboratories with large groups. However, since June 2008, under the TI pole of the University Bordeaux 1, the creation of a joint Bordeaux 1/Thales laboratory is under way. From 2010, two LaBRI teams (LSR and MF) will be involved with this laboratory. In the longer term other LaBRI teams should take part in this laboratory.
Finally the LaBRI has numerous collaboration contracts with regional enterprises. These contracts principally financed by the Aquitaine region do not take into account the salaries of the permanent staff, which explains the low level of their financial value. On the other hand, intellectual property clauses will allow the LaBRI to obtain significant financial resources in the event of the success of these enterprises. This collaboration with Aquitaine enterprises has always been a desire of the LaBRI, which is seen by the Aquitaine Region as an important actor in the local economy in the domain of Information Technology. It should be remembered that the average annual support by the Regional Council is of the order of 300 K€. As an example, the LaBRI is an active partner in the TOPOS association which unites the regional actors concerned with the Galileo question and more generally that of geo-localisation. This involvement has allowed the laboratory to establish collaborations with regional companies (GéoLoc system, Fly-n-Sens).

An important element to consider in the LaBRI’s industrial relations is the growth in the number of CIFRE theses. This number has increased from three theses signed in 2005 to nine in 2008. During the period 2005-2008, nineteen CIFRE theses have been signed for a contractual sum of 400 K€ for the scientific accompaniment. Apart from the financial support, this policy of development of CIFRE theses allows us to start collaborations with enterprises which often lead to larger scale contracts.

In a desire to collaborate with local industry, the LaBRI has organised three research/industry meetings on the themes of Geolocalisation, Security and 3D Imagery in order to make the competences of the LaBRI in these fields more widely known.

### 1.1.10 Governance

The management team consists of 4 deputy directors, allowing us to be present at all the meetings to which we are invited by our governing authorities and certain organisms (MIB Carnot, GIS materials, Regional Council, Competitivity poles, ...). One deputy director was director at the end of the previous contract and, in 2010, another of the deputy directors will be the new director of the laboratory. This mode of functioning allows us to keep a “memory” of our procedures and of the operations under way. Three persons have been put in charge of each of three areas: communication, computing resources, international relations. To better manage the LaBRI, we have set up a Scientific Council which discusses the major orientations before the Laboratory Council. This Scientific council which is limited to the team heads meets about every three months and classes the laboratory’s priorities (PHD, University call, resource requests). Similar to this Scientific council, the Administrative and Technical Council concerns these staff, service organisation and their specific needs. It has met once a year. Minutes of the totality of meetings are accessible to members of the laboratory on the intranet.

### 1.1.11 Financial resources

In accordance with the 2007-2011 quadrennial contract, the LaBRI’s finances are spread over the establishments employing its members. The funds provided by the quadrennial contracts of the Universities Bordeaux 1 and 2 are managed by Bordeaux 1. Also, industrial contracts, European or ANR projects are divided between the establishments (including INRIA) but principally Bordeaux 1. Finally certain industrial contracts are managed by the SAIC of the University Bordeaux 1 or by the ADERA.

The laboratory’s policy concerning credits is voluntaristic. Firstly, we have invested so as to anticipate the needs of our colleagues both for machine rooms and for the equipment itself. Too often it is necessary to await numerous replies before undertaking important purchases. We believe that it is the role of a laboratory to anticipate these expenses, if the equipment is necessary for colleagues’ visibility and work, even at the “risk” of not obtaining funding. The following equipment purchases have been anticipated in this way:

- Replacement of the air conditioning in the historic machine room
- Multi-core computer for SATANAS team,
- 3D printer (Image and Sound team),
Moreover, following a suggestion of the Laboratory Council, we have increased the part of funding of missions attributed to laboratory members by request to the president of the Scientific council. Finally we have funded employment in the administrative cell (*helped contract CAE* and from October 2009 2 team assitants) and in certain sectors judged to be important: web and HAL (student employment). We also judged it important to improve the working environment by a first stage of office refurbishment and furniture replacement. In 2010 we will equip our building with a documentation and relaxation room, thanks to the assistance of the University Bordeaux 1. We have been able to finance all of these measures thanks to the systematic deduction, since 2008, of the 4% of overhead on ANR contract. We do not for the moment make any such deduction on industrial contracts as was decided by the previous management. The graphs represent the financial resources of the LaBRI over the period 2005-2008. The graph 1.6 shows the division of resources between authorities and partners. One can see a regular increase in funding by the CNRS but also a large decrease in assistance coming from INRIA since the installation of the Bordeaux-Southwest unit.

The graph 1.7 shows the relationship between recurrent and contract funding. The division of contract funding according to different types of resources is shown in graph 1.8. One can see a significant increase in ANR and industrial contracts at the expense of European contracts difficult to finalise and so having less chance of success. The support of the Aquitaine Region is also always present. Its higher contributions in 2005 and 2006 correspond to the stages of investment in Hémicyclia and GRID. It is clear that this support is essential for the LaBRI’s equipment.

The graph 1.9 shows the division of expenditure in the period 2006-2008 into nine categories: missions, conferences and reception, telephones and postage, charges (in particular LaBRI-transfert), administrative salaries, investments, documentation (Maths-Info library), maintenance and repairs, supplies.

It can be clearly seen that investment expenditure (GRID 5000, Hémicyclia, HD Video, Sound studio and 3D printer) predominates over other categories. These latter categories are co-financed to a large degree by the Aquitaine Region and the CNRS. Moreover, the deployment of the GRID operation has received a significant support from INRIA. The investment peaks took place in 2007: Hémicyclia (virtual reality room) re-equipment after a major theft, equipment of the GRID room and the technological set. The expenditure in charges are due to the restructuring of the historic machine room and certain offices in the old part of the LaBRI building and to the financing of

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**Figure 1.6 – Recurrent funds**
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Figure 1.7 – Recurrent funds versus contract funding

Figure 1.8 – Origin of contracts
Figure 1.9 – Division of expenditure
LaBRI-Transfert.

1.1.12 Systems and networks team

As of 1 July 2009, the systems and networks team consists of 5 permanent staff (1 IR, 2 IGE, 2 ASI). This team which has received CNRS CATI (Centre Automatisé de Traitement de l’Information) accreditation offers a personalised assistance to users and manages the functioning and evolution of the laboratory’s systems and hardware. It gives advice and provides locations for the research material ranging from minor material to complex technological platforms. Working in close collaboration with other engineering teams on joint projects, it hosts web sites whose number, and for certain amongst them the wide reputation (for instance Génolevures), make them an increasingly critical service. Thus the computing functioning of our laboratory depends heavily on this team. Two difficult points must be raised. Firstly, in four years, staff movements have been too numerous:
- the person in charge of the team chose to join the INRIA unit,
- an engineer who had come from INRIA and been recruited on a NOEMI post has left to rejoin INRIA
- three contract staff have succeeded each other without there being any possibility of stabilising them.

This staff turnover has a negative impact on the background work because all staff recruited have to be trained in the environment. So it is important to be able to rapidly increase the potential of this team with permanent appointments.

Moreover the CNRS CATI accreditation has led to the payment of PFI (Primes de Fonction Informatique) bonuses to CNRS staff. Bordeaux 1 staff do not receive these bonuses. So there are staff with the same function and carrying out the same work who are not rewarded at the same level.

The principal operations of this quadrennium have been:
- Rehabilitation of server spaces and creation of new spaces,
- Revision of the LaBRI network,
- Installation of a system of monitoring of computing equipment with generation of alerts in the event of expiration of guarantee,
- Redundance of critical services and recovery procedures in the event of any incident,
- Virtualisation of servers,
- Elaboration of the polycu for data system security.

1.1.13 Hygiene and Security

The LaBRI’s building and activities do not involve any major risk for its staff. Nevertheless the management does everything necessary to meet its legal responsibilities as laid down by the “Code du Travail”, in particular concerning the principal risk, namely of a fire in the building. The post of ACMO is held by G. Point (IR CNRS). He assists and advises the Unit directress and informs staff working in the building and makes them aware of questions concerning Hygiene and Security regulations and practises. The LaBRI has formed a team of 12 evacuation agents, 3 fire centre managers and 8 first aid workers trained to the level PSC1 (Protection and civil first aid level 1).

The risks to which laboratory staff are exposed being minor, Hygiene and Security questions are considered in the laboratory Council.
1.2 Inter-team publications

1.2.1 Overview

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<td>47</td>
<td>386</td>
<td>1793</td>
</tr>
</tbody>
</table>

The difference between the sum of the team publications and the sum for the whole LaBRI can be explained by the publications involving several teams.

1.2.2 Publications with non-LaBRI members

The table below indicates the percentage of the publications including at least one coauthor who is not an “author of the LaBRI”\(^1\). Concerning the talks, the invited talks are not counted (Ci).

<table>
<thead>
<tr>
<th></th>
<th>Journals</th>
<th>Conferences</th>
<th>Total</th>
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The publications involving several teams explain why the line "LaBRI" is not the average, even weighted by the size of the teams, of each column.

1.2.3 Inter-team overview

1.2.4 Inter-team Publications

BIBLIOGRAPHY

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[31] N. Couture and G. Riviere, Faisabilité d’une interface tangible pour la validation d’hypothèses en géosciences, in 3é Journées Francophones Mobilité et Ubiquité (Ubimob’06), ACM, 2006, pp. 163–164. [hal-00176608]


[34] B. Derbel, M. Mosbah, and A. Zemmari, Fast distributed graph partition and application (extended abstract), in 26th IEEE International Parallel & Distributed Processing Symposium (IPDPS), 2006.


[55] P. Hanna, M. Robine, and P. Ferraro, *Visualisation of musical structure by applying improved editing algorithms*, in International Computer Music Conference (ICMC), 2008. [hal-00345346]


BIBLIOGRAPHY


Team

Combinatorics and Algorithms
(COMBALGO)

Head: M. BOUSQUET-MÉLOU

Activities:

- Theme Distributed Algorithms
  Head: Y. MÉTIVIER
  Keywords: local computations, leader election, termination detection, graphs recognition, covering maps, fibers, randomized algorithms, mobile agent computing, fault-tolerance, self-stabilization, token circulation, peer to peer networks, communication models, dynamic networks

- Theme Enumerative and Algebraic Combinatorics
  Head: J.-C. AVAL
  Keywords: enumeration, limit laws, exhaustive and random generation, maps, trees, paths, plane partitions, permutations, polynomial invariants and coinvariants

- Theme Graphs and Applications
  Head: E. SOPENA
  Keywords: coding, coloring, list coloring, labeling, homomorphism, combinatoric optimization, polytopes, structural properties, routing in networks, compact data structures

- Team-Project Cépage
  Head: O. BEAUMONT
  Keywords: Large Scale Computing, Graph Exploration, Failure Detection, Modeling, Distance Approximation, Peer-To-Peer Networks, Dynamism in Networks, Scheduling, Graph Decomposition
2.1 Members
(at 31st of August 2009)

T₁: Theme Distributed Algorithms
T₂: Theme Enumerative and Algebraic Combinatorics
T₃: Theme Graphs and Applications
E₄: Team-Project Cépage

2.1.1 Permanent faculty

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Total ETPC²: 20.5 (PR: 8 DR: 3 MCF: 13 CR: 7)

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¹ Restricted to (vice-)presidents and (deputy-)directors of school, laboratory, department, and of international relationships.
² Equivalent Temps Plein Chercheur.
2.1.2 Temporary personnel

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1. Prorata temporis.
2.2 General Presentation

Computing defines, studies and manipulates finite or discrete structures by means of algorithms. A natural and important framework for describing this activity is combinatorics. Algorithms use combinatorial objects constructions and analyses. Inversely these algorithms give rise to new combinatorial problems. Among the most commonly encountered structures we note words, trees and more generally graphs, maps but also more algebraic structures (permutations etc.).

Thus the research carried out by this team covers a continuous range extending from combinatorics to algorithmics. Combinatorial questions are fundamental to our work: understanding the structure of objects, enumerating them and determining their properties, either intrinsic (for instance properties of colourability in graph theory) or statistical (the study of the asymptotic distribution of parameters in a class of very large objects). These properties in turn lead to the design of efficient algorithms and the study of their complexity. There is an emphasis on distributed and/or probabilistic algorithms, random generation, the search for compact data structures and encodings and (explicit) computations on the objects.

The team is structured in three themes (Distributed algorithms, Enumerative and algebraic combinatorics, Graphs and applications), intermingled with two INRIA project teams (CEPAGE and RealOpt). About a quarter of the members take part in several themes. Whereas the members of the CEPAGE project, devoted to data for large scale dynamic platforms) are a subset of the team, the RealOpt project is quite different including only one member of the team, the others belonging to the IMB (Bordeaux Mathematics Institute). For this reason, in what follows, we present our activities in the form: the three themes (RealOpt included in the Graphs and applications theme) followed by the CEPAGE project.

Before starting on this presentation, we emphasise what we consider the strengths of this team: first its level of publications; a solid international reputation (shown notably by our involvement in conference organisation, journal editing and many collaborations including funded projects); our ability to give rise to new research projects (the two former "Bioinformatics" and "Visualisation" projects are now independent in the new Mabiovis team) and to accept others (the arrival of CEPAGE, development of probabilistic aspects, links with statistical physics); and finally the very good "swarming" of our doctoral students (for example five of our recent Ph.D.s have been recruited as researchers in the CNRS, and one as professor at MIT). Section 1.3 and various tables give more details.

2.2.1 Distributed Algorithms

The distributed Algorithms theme is interested in tools for coding, studying and teaching different aspects of distributed algorithmics.

A distributed system is a collection of autonomous communicating entities. Each entity (called variously node, process, processor, machine, etc.) has its own code, its own objectives, its execution speed, etc. In a distributed system, the communications are represented by a graph: different processors can communicate directly only with a limited number of other processors, their "neighbours". Distributed algorithmics aims to decide what global tasks can be accomplished by such systems and under what conditions. The principal issue is to produce the desired global behaviour in systems where the actions of each processor have only a local impact.

Numerous domains use distributed algorithms: telecommunications, ad hoc networks, detector networks, peer to peer networks and distributed data bases.

An important research direction for the team is the study of the boundary between the existence and non-existence of distributed algorithms to resolve certain problems such as: election, labelling, computation of a spanning tree, termination detection, synchronisation or recognition of certain properties of the network. These studies depend on, on the one hand, the type of interaction: local computation, message passing or shared memory, and, on the other hand, the initial state or knowledge of the network. We studies the links between these models and mobile agents. This
CHAPTER 2. TEAM COMBALGO

research direction is naturally involved with the invention and analysis of probabilistic distributed algorithms.

A second research direction is the design of distributed algorithms reliable or safe even in the presence of perturbations with, in particular, an interest in self stabilising algorithms. These algorithms can withstand a succession of perturbations over a period of time or alternatively function without initialisation of the network. After the perturbations the system corrects itself to return to correct functioning. These self stabilising algorithms are naturally resistant to process mobility, simple breakdowns or modifications in the topology of the network.

Principal research results

- Establishing an equivalence between systems of mobile agents and distributed systems [Ca28].
- Formalisation of different forms of termination for a distributed system. Discovery of necessary and sufficient conditions for obtaining one of these forms [Ca29, Cs22].
- An election algorithm for asynchronous networks communicating by asynchronous messages and using a polynomial number of messages of polynomial size, thereby improving on the previously known algorithms which use messages exponential size [Ra33].
- A probabilistic election algorithm for trees which gives the same chance of being elected to each vertex [Rs67].
- An optimal probabilistic algorithm for calculating a maximal independent set which uses a number $O(\log n)$ of communication bits on each channel for a graph of size $n$ citehal-00370970.
- An optimal probabilistic algorithm for colouring the vertices of a graph which uses a number $O(\log n)$ of communication bits on each channel for a graph of size $n$.

2.2.2 Enumerative and algebraic combinatorics

One of the principal activities of this theme is the solution of purely enumerative problems, often motivated by questions coming from other disciplines such as statistical physics or algorithm analysis.

Imagine a family of discrete objects arising from computation, mathematics, a physical model, from biology or from any other field. Attempting to enumerate its elements requires us to better determine the structure of these objects. To take a definite example, a recurrence relation on the number $a_n$ of objects of size $n$ reflects, in general, the existence of a certain recursive description of the objects. It is this description which enlightens us about their structure.

At the end of the study, one obtains, of course, quantitative information about the objects. The form of the result often reveals certain structural properties. Asymptotic estimations to the numbers $a_n$ also allow comparison of different families on the same scale.

Finally simultaneous enumeration with respect to several parameters, together with an asymptotic study of the result, provides information on the general form of the objects (a planar tree of $n$ vertices has, on average, $n/4$ leaves). In the most favourable cases, one may manage to uncover limiting probability distributions (the number of leaves of these trees, correctly normalised, converge to a Gaussian distribution), and to establish a link with continuous stochastic processes.

Apart from these general motivations, some enumeration problems have more specific natural justifications, coming in particular from the two fields of particular interest to this theme: algorithm analysis and statistical physics.

Other families of discrete objects possess, in addition, an algebraic structure (group, ring, algebra) which can be studied as such. This is an active field of research on an international level, in which our theme participates also. We can illustrate this branch of our activities by an example: the set of permutations on $n$ letters. This set constitutes a group, whose theory of representations (by Young tableaux) and polynomial incarnation (the ring of symmetric polynomials) give rise to a rich and flourishing combinatorial research.
Principal research results

A part of our research is carried out within projects supported by the ANR:

- the SADA (Discrete random structures and algorithms [2006-2009]) project whose objective is a very precise study of the "profiles" of random objects appearing in various computing applications (words, trees, graphs). This project groups more than 30 French researchers including six members of the theme (O. Bernardi, M. Bousquet-Mélou, R. Cori, P. Duchon, Y. Le Borgne, J.-F. Marckert). We have, for example, determined the profile of the labelled trees coding planar maps and applied these results to the random measure ISE (integrated superbrownian excursion) [Rs13, Ra16]. We have also obtained an asymptotic description of the profile of a family of planar maps under several distributions [Ra1]. Also in connection with maps, two remarkable bijections have been established yielding the first combinatorial proofs of two enumerative results dating back to the sixties [Ra10, Rs7]. We also mention a new description of the Tutte polynomial (a two variable graph invariant) which allow a unification of the proofs of many results, according to which certain specialisations of this polynomial count the structures (trees, orientations, etc.) drawn on the graphs [Ra11, Ra14].

- The MARS (Alternating sign matrices and the Razumov-Stroganov conjecture [2006-2009]) project, whose objective is a better understanding of the structure of objects called Alternating sign matrices (MSA). These polymorphic objects appear in various domains, in particular in some difficult problems of statistical physics. Five members of the theme (Aval, Duchon, Le Borgne, Marckert, Viennot) participate in this project. Concerning enumeration, two significant results are the enumeration of MSA of size $4n + 2$ invariant under quarter rotations [Cs2] and the proof of the symmetry of the partition function of the ice model on a square network, whose configurations are in bijection with the MSA [Ra4]. Another aspect of our work concerns random generation of symmetry classes of MSA.

- The A3 (Random continuous trees and applications [2009-2012]) project, aims to study fragmentation and percolation processes, discrete trees and combinatorial maps and their convergence to continuous trees and maps. It groups around twenty members on six sites in France. Four members of our theme (Albenque, Bernardi, Bousquet-Mélou, Marckert) take part in this new project and in recent years have obtained numerous results in these fields concerning convergence of maps and trees [Rs65, Ra1, Rs66, Rs65, Rs13, Au82]...

In addition to the work carried out in connection with ANR projects, certain classical combinatorial objects such as permutations are still the subject of considerable activity: for example, the study of classes of permutations with a forbidden pattern by means of generation trees, the discovery of a bijection between Baxter permutations and [Ci14], orientations of planar maps [Ca21] and also the study of non-decomposable permutations connected to hypermaps [Ra35].

Algebra constitutes an important tool in much of the above mentioned work. But certain algebraic objects are also studied in their own right, (permutation groups, polynomial ideals, algebras defined on trees, etc.) : amongst our results are an explicit description of diagonally quasisymmetric and B-quasisymmetric polynomial ideals [Ra5] [Ra2], the computation of the product in the Loday-Ronco binary tree algebra, obtaining the key of a Young tableau by an elementary matrix computation, the "children’s drawings", and also a counterexample to a conjecture concerning the moment problem for Laurent polynomials [Au103].

2.2.3 Graphs and applications

Graph theory is a powerful tool in the investigation of complex combinatorial structures. The research of this team concerns the development of this theory and its applications, notably in the field of communications in networks.

The problems which we study in graph theory are the most recent developments of classical problems or problems arising from new research directions. Examples include problems related to Hamiltonianism, colourings or the computation of invariants. The notion of oriented colouring, for example, has been introduced and developed at the LaBRI and is now widely studied in the international community. The work of this theme also concerns parameters of general graphs.
and more strongly structured graphs (planar, bounded tree-width, etc.), computation of compact routing tables, distance labelling, communication algorithms, graph coding and also combinatorial games on graphs.

Members of the theme are strongly involved in numerous projects, including ANR projects (ALADDIN, IDEA, GRATOS etc.) and have established strong international partnerships (England, China, Israel, Poland, Czech Republic, Slovakia, Taiwan, etc.).

**Principal research results**

As an illustration of the impact and diversity of the activities undertaken, some notable achievements:

- the proof by Daniel Gonçalves of a long standing conjecture (Chartrand, Geller and Hedetnimi 1971) that every planar graph is edge-partitionable into two outer planar graphs (best student paper at STOC 2005 [Cs43])
- obtaining in 2009 an industrial contract with ALCATEL on the acknowledged competences of the team ("Dynamic Compact Routing Scheme"), for a sum of 130k€
- the research undertaken on "small world" (networks, social) graphs, awarded the best article prize (of the ACM) at SPAA 2006 [Ca58]

The following list gives some of the principal results obtained in the last four years, in addition to those already cited:

- **Graph colouring, decomposition, structural properties**:
  - Study of numerous graph invariants (chromatic number, circular chromatic number, list chromatic number, adaptable chromatic number, star chromatic number, oriented chromatic number, linear chromatic number, acyclic chromatic number, incidence chromatic number, mixed graph homomorphisms, (arbitrarily) recursively decomposable graphs) [Rs16, Ra50, Ci22, Ra87, Ra100, Rs79, Ra101, Rs56, Ra94, Au85, Ca9, Rs57, Rs69, Rs3, Rs72, Rs36, Rs71, Rs70, Ra91, Rs68, Ra88, Ra89, Ra90],
  - Study of combinatorial colouring games : characterisation of winning positions for different types of game sum [Rs53],
  - Establishing the $k$-separability of minor free graphs [Ca8],
  - Study of the algorithmic and structural properties of generalisations of perfect graphs [Rs22, Ca105].

- **Routing and coding**:
  - obtaining the best known coding for unlabelled planar graphs [Ca68],
  - obtaining the first deterministic and local algorithms for computing optimal "spanners" [Cs17].

- **Graphs and polyhedra**:
  - Study of the polytope of stable sets of claw free graphs [Ra97, Rs76],
  - Establishing optimal bounds for the imperfection ratio [Ra36].

The activities of this theme also contribute to RealOpt, a very new (official creation in 2009) INRIA team-project led by F. Vanderbeck (Institut de Mathématiques de Bordeaux), whose objective is to work on the quality of formulation of combinatorial optimisation problems. The chosen approach consists of combining advanced techniques such as the polyhedral approach, the Lagrangian decomposition approach and techniques coming from non-linear optimisation and graph theory. Four participants in the theme (M. Montassier, A. Pécher, A. Raspaud and E. Sopena) are members of this INRIA team.

**EPI CEPAGE**

The CEPAGE team-project is a new INRIA team-project led by O. Beaumont (official creation in 2009). This team is interested in the design of algorithms and data structures and their deployment on large scale dynamic platforms. These platforms are characterised by their being heterogeneous (in computing and communication resources) and dynamic (variations in performance and resources). The team’s objective is to design algorithms whose performance for classical problems
(diffusion of data, distribution of computing tasks) can be guaranteed, drawing inspiration from solutions from parallel algorithmics and peer to peer systems. A first direction of work concerns the design of (primitives for) high level services for programming large scale networks such as volunteer computing platforms whose use is currently limited to client server type applications. The objective is to enrich this model, proposing guaranteed performance distributed services for data localisation, treatment units subgroup construction, etc. and to validate the proposed solutions on concrete applications (steering molecular dynamics code, continuous integration) and large scale platforms such as PlanetLab or GRID’5000.

A second direction of work considers the algorithmics of mobile agents in networks. Mobile agents (robots or software agents) are required to accomplish a complex task (exploration mapping, searching a mobile intruder or a specific node, rendez-vous etc.) in a network which they do not know a priori. The accent is on the memory space used by the agents.

**Principal research results**

- Construction of logical networks for managing complex requests guaranteeing polylogarithmic routing for different graph families. [Ca48, Rs30]
- A distributed algorithm for bin covering (with a distance constraint) giving a performance guarantee [Ca13, Ca12]
- Results in steady-state scheduling of independent tasks [Rs4], collective communication [Ra9] and divisible tasks [Cs5]
- Efficient derandomisation of random walks in undirected graphs using local exploration strategies [Cs25] and periodic traversal of anonymous undirected graphs [Ra61]
- An efficient algorithm for attachment in dynamic distributed networks [Rs25].
- The demonstration of an equivalence between the whiteboard model and the pebble model for the problem of mobile agent search for malicious nodes in a network [Cs34].
- A deterministic distributed algorithm in $k$ rounds for the computation of covering subgraphs of size $O(kn^{1+1/k})$ approximating the distances to within a factor $2k - 1$ [Cs17].
- A routing algorithm finding almost shortest paths (stretch factor $1 + \epsilon$) with polylogarithmic size for graphs with a fixed excluded minor (planar, surface of bounded genus, etc.) [Cs3] and a universal routing algorithm (that is for an arbitrary weighted graph) using local routing tables of size $n^{1/k}$ for a stretch factor of $O(k)$ respecting name independence
- A new greedy algorithm, based on an augmentation of a semi-metric of distortion $O(\log n)$, defined for all graphs and allowing routing in a polylogarithmic number of steps [Ca66].

### 2.3 Notable achievements

- **Research themes**: We emphasise our activity around the "small world" effect (networks, social, etc.) This work originating in Bordeaux has been taken up by J. Kleinberg in his address to the International Mathematicians conference in Madrid in 2006, where he received the Nevanlinna prize. This activity (largely inter-theme or even inter-team) was awarded an ACM prize at SPAA (Symposium on Parallelism in Algorithms and Architectures) in 2007.
- **Doctoral students**: Our team attracts and trains very good young researchers: for example, five of our recent Ph.D.s have been recruited as CR by the CNRS.
  - The national experiment of “doctorants-conseils”, initiated by Yves Métivier (LaBRI), was officially launched in Bordeaux by Valérie Péresse in 2007.
– Charles-Louis de Saulses de Freycinet prize (biennial Academy of Sciences prize created in 1925, to encourage research in Mathematics) awarded to M. Bousquet-Mélou (LaBRI)
– Contracts: in addition to numerous institutional contracts, we emphasise the existence of an ALCATEL industrial contract (130 KEuros) on the acknowledged competences of our team.

Competitive examination Awards

2.4 Visibility

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<tr>
<td>Evaluation (laboratories, projects, ...)</td>
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<td>External refereing (int’l)</td>
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<td>External reviewer for foreigner HDR or thesis</td>
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2.5 Jurys

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<td>Habilitation (but LaBRI)</td>
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<tr>
<td>Thesis (but LaBRI)</td>
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<tr>
<td>Competitive examination</td>
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<td>Award committee</td>
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2.6 Collaborations, contracts and valorization

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<td>Conventions</td>
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<td>Joint publications</td>
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<td>Other</td>
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<td>Guest</td>
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<td>Invitation</td>
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<td>Institutional contracts</td>
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<td>Industrial contracts</td>
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<td>Software pre-patented</td>
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For world map, see Figure 1.2.

2.7 Thesis and HDR

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<td>Thesis LaBRI</td>
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<td>Jointly advised thesis</td>
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2.8 Publications of the team COMBALGO

2.8.1 Summary

<table>
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<tr>
<th>Team COMBALGO</th>
<th>selection</th>
<th>invited</th>
<th>others</th>
<th>total</th>
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<tr>
<td>Journals</td>
<td>81</td>
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<td>Conferences</td>
<td>52</td>
<td>57</td>
<td>108</td>
<td>217</td>
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<tr>
<td>Books</td>
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<td>Other publications</td>
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Be reminded that all the publications listed here under the category Journals and the vast majority of those listed under the category Conferences and Books (and many of those listed under the category Other) are publications of Rank A as defined by the AERES. Indeed, it is the team that has chosen the journals and the conferences that are highlighted with the label Selection in order to put emphasis on certain publication media, and in no case does this imply the declaration of the complement of this selection as being of lower quality.

2.8.2 Journals [ACL]

(journals with editorial board registered by AERES or by international data bases)

Selection


[Rs3] F. Bazzaro, M. Montassier, and A. Raspaud, (d,1)-total labeling of planar graphs with large girth and high maximum degree., Discrete Mathematics, 307 (2007), pp. 2141–2151. [hal-00293465]
[Rs8] O. Bernardi and N. Bonichon, Catalan’s intervals and realizers of triangulations, Journal of Combinatorial Theory Series A, 116 (2009), pp. 55–75. [hal-00142870]
BIBLIOGRAPHY – COMBALGO


[Rs16] O. Borodin, A. Glebov, M. Montassier, and A. Raspaud, Planar graphs without 5- and 7-cycles and without adjacent triangles are 3-colorable., Journal of Combinatorial Theory, Series B, 99 (2009), pp. 668–673. [hal-00349110]

[Rs17] O. Borodin, A. Glebov, A. Raspaud, and M. Salavatipour, Planar graphs without cycles of length from 4 to 7 are 3-colorable, Journal of Combinatorial Theory Series B, 93 (2005), pp. 303–311. [hal-00307587]

[Rs18] O. Borodin, M. Montassier, and A. Raspaud, Planar graphs without adjacent cycles of length at most seven are 3-colorable, Discrete Mathematics, (2009). [hal-00401710]


BIBLIOGRAPHY – COMBALGO


BIBLIOGRAPHY – COMBALGO


Other


[Ra4] J.-C. Aval, On the symmetry of the partition function of some square ice models, Theoretical and Mathematical Physics, (2009). [hal-00365802]


Other


BIBLIOGRAPHY – COMBALGO


[RA57] C. Gavoille and N. Hanusse, On compact encoding of pagename k graphs, Discrete Mathematics & Theoretical Computer Science, 10 (2008), pp. 23–34. [hal-00402218]


[RA59] D. Gonçalves, A planar linear hypergraph whose edges cannot be represented as straight line segments, European Journal of Combinatorics, 30 (2009), pp. 280–282. [hal-00338324]


[RA70] D. Ilcinkas and A. Pelc, Impact of asynchrony on the behavior of rational selfish agents, Fundamenta Informaticae, 82 (2008), pp. 113–125. [hal-00341579]


BIBLIOGRAPHY – COMBALGO


2.8.3 Conferences [INV, ACTI, ACTN]

(invited conferences, international or national conferences with proceedings)

Selection

( STOC, SODA, ICALP, PODC, IPDPS, FPSAC, STACS )

[Cs1] J.-C. Aval, Multivariate fuss-catalan numbers and b-quasisymmetric polynomials., in FPSAC’06., 2006. [hal-00353525]


Invited
(invited speaker in international or national conferences)


[C133] X. G. Viennot, De leonhard euler (1707-1783) aux mathématiques combinatoires et à la physique d’aujourd’hui, in Les Rendez-vous du Lundi, Université de Bordeaux, 2007.


Other


BIBLIOGRAPHY – COMBALGO


2.8.4 Books [OS, OV]

(scientific book or chapter)


2.8.5 Other publications [ACLN, ASCL, COM, AFF, DO, AP]

(revues without review process, oral contribution without proceedings, poster, editorial board, registered software, translations and technical reports, intermediate reports for large project)


[Au34] M. Bousquet-Mélou, Prudent self-avoiding walks, in Colloque en l’honneur de Philippe Flajolet, 2008. [hal-00355759]


[Au38] M. Bousquet-Mélou and M. Mishna, Walks with small steps in the quarter plane. 2005. [hal-00333741]


[Au52] O. Delmas and A. Raspaud, 7th international colloquium on graph theory - icgt 05. 2009. [hal-00411734]


BIBLIOGRAPHY – COMBALGO


BIBLIOGRAPHY – COMBALGO  68


2.9 Annexe A: Visibility

2.9.1 Editorial board, invited editor

- Journal of Combinatorial Theory, Series A, M. Bousquet-Mélou (editor since 2001, member of the Advisory board from 2001 to 2007)
- Advances in Applied Mathematics, M. Bousquet-Mélou (editor since 2001)
- Theoretical Informatics and applications, Y. Métivier editorial board since 2002
- Special issue of Theory of Computing Systems (TOCS) devoted to SPAA’07 - Symposium on Parallelism in Algorithms and Architectures co-editor : C. Gavoille
- Special issue of Electronic Notes in Discrete Mathematics devoted to ICGT’05 - 7th International Colloquium on Graph Theory (editors : O. Delmas, A. Raspaud)
- Special issue of International Journal of High Performance Computing Applications following HeteroPar’07 (invited editor : O. Beaumont)
- Kyungpook Mathematical Journal, Associate editor, A. Zvonkine (since 2008)
- Séminaire Lotharingien de Combinatoire, M. Bousquet-Mélou (editor since 2007)
- Special issue of TSI following Renpar (invited editor : O. Beaumont)

2.9.2 Program committee

- ISCIS 08, International Symposium on Computer and Information Sciences (co-chair) Parallel Distributed and Grid Systems Symposium, Istanbul, Turquie (O. Beaumont)
- HeteroPar 07 (chair), International Workshop on Algorithms, models, and tools for parallel computing on heterogeneous networks, Austin, 2007 (O. Beaumont)
- LOCALITY ’05 (PC co-chair, workshop co-located with DISC ’05, sep. 26, Cracow, Poland), Locality Preserving Distributed Computing Methods (C. Gavoille)
- RenPar 06 (co-chair) Rencontre du Parallélisme, Perpignan, 2006 (O. Beaumont)
- ENC ’06, Mexican International Conference on Computer Science (E. Sopena)
- FPSAC ’08 (Formal Power Series and Algebraic Combinatorics), Chili, juin (JC Aval)
- FPSAC ’07, Nankai, Chine, juillet 2007 (Formal power series and algebraic combinatorics) (M. Bousquet-Mélou)
- SIROCCO ’09 (16th International Colloquium on Structural Information and Communication Complexity), Piran, Slovenie, mai (D. Ilcinkas)
- SIROCCO ’07 (Y. Métivier)
- DISC ’08 (Sep. 22-24, Arcachon, France), International Symposium on Distributed Computing (C. Gavoille)
- DISC ’07 (Sep. 24-26, Lemesos, Cyprus), International Symposium on Distributed Computing (C. Gavoille)
- OPODIS ’09 (Dec., Corsica, France), International Conference on Principles of Distributed Systems (C. Gavoille)
- OPODIS ’07 (Y. Métivier)
- PODC ’08 (August 18-21, Toronto, Canada), Annual ACM Symposium on Principles of Distributed Computing (C. Gavoille)
- PODC ’06 (July 23-26, Denver, Colorado, USA), Annual ACM Symposium on Principles of Distributed Computing (C. Gavoille)
- PODC ’05 (Jul. 17-20, Las Vegas, Nevada, USA), Annual ACM Symposium on Principles of Distributed Computing (C. Gavoille)
- SPAA ’07 (June 9-11, San Diego, Californie, USA), Symposium on Parallelism in Algorithms and Architectures (C. Gavoille)
- PDCN ’07 (Feb. 13-15, Innsbruck, Austria), Parallel and Distributed Computing and Networks (C. Gavoille)
- PDCN ’06 (Feb. 14-16, Innsbruck, Austria), Parallel and Distributed Computing and Networks (C. Gavoille)
- PDCN ’05 (Feb. 15-17, Innsbruck, Austria), Parallel and Distributed Computing and Net-
works (C. Gavoille)
- HiPC '05 (Dec. 18-21, Goa, India), International Conference On High Performance Computing (C. Gavoille)
- IWDC '05 (Dec. 27-30, Kharagpur, India), International Workshop on Distributed Computing (C. Gavoille)
- ISCIS '09 Northern Cyprus, septembre (O. Beaumont)
- ISPDC '09, 8th International Symposium on Parallel and Distributed Computing, Lisbon, Portugal (O. Beaumont)
- HeteroPar '09, International Workshop on Algorithms, models, and tools for parallel computing on heterogeneous networks, August '09, Delft, The Netherlands (O. Beaumont)
- IPDPS '09, IEEE International Parallel and Distributed Processing Symposium, Rome, Italie (O. Beaumont)
- IPDPS '07, IEEE International Parallel and Distributed Processing Symposium, Long Beach, USA (O. Beaumont)
- IPDPS '06, IEEE International Parallel and Distributed Processing Symposium, Rhodes Island, Greece (O. Beaumont)
- ICPADS '08, IEEE International Conference on Parallel and Distributed Systems, Melbourne, Victoria, AUSTRALIA (O. Beaumont)
- PMAA '08, International Workshop on Parallel Matrix Algorithms and Applications, Neuchâtel, Switzerland (O. Beaumont)
- EuroPar '07 (Local Chair, Scheduling and Load Balancing), Rennes, France (O. Beaumont)
- EuroComb '07 Bordeau, septembre (R. Cori, A. Raspaud, E. Sopena)
- PMGC '07 Workshop on Programming Models for Grid Computing, Rio de Janeiro, Brazil (O. Beaumont)
- ICPADS '06 International Conference on Parallel and Distributed Systems (Minneapolis, USA) (O. Beaumont)
- HeteroPar '06 International Workshop on Algorithms, models, and tools for parallel computing on heterogeneous networks (Barcelona, Spain) (O. Beaumont)
- PMAA '06 International Workshop on Parallel Matrix Algorithms and Applications, Rennes, France (O. Beaumont)
- STACS '06 (A. Zvonkine)
- 4th Colloquium on Mathematics and Computer Science : Algorithms, Trees, Combinatorics and Probabilities, septembre '06, Nancy, France. (M. Bousquet-Mélou)
- AlgoTel '08 (10èmes Rencontres Francophones sur les Aspects Algorithmiques de Télécommunications), Saint Malo, France, mai (P. Duchon)
- AlgoTel '08 (11èmes Rencontres Francophones sur les Aspects Algorithmiques de Télécommunications), Carry-Le-Rouet, France, juin (D. Ilcinkas)
- AlgoTel '08 (May 13-16, Saint-Malo, France), Rencontres Francophones sur les aspects Algorithmiques des Télécommunications (C. Gavoille)
- AlgoTel '07 (May 29 - Jun 1, Ile d’Oléron, France), Rencontres Francophones sur les aspects Algorithmiques des Télécommunications (C. Gavoille)
- RenPar 09, Rencontre du Parallélisme, Toulouse, France (O. Beaumont)
- RenPar '08, Rencontre du Parallélisme, Fribourg, Switzerland (O. Beaumont)
- JDIR '09 (Feb. 2-4, Belfort, UTBM, France), Journées Doctorales en Informatiques et Réseaux (C. Gavoille)
- JDIR '08 (Jan. 16-18, Villeneuve d’Ascq, France), Journées Doctorales en Informatiques et Réseaux (C. Gavoille)

2.9.3 Conference organization
- DISC 2008 (22nd International Symposium on Distributed Computing) et workshops colocalisés (en tout, 140 participants) septembre 2008 (C. Gavoille, N. Hanusse, D. Ilcinkas, R.
2.9.4 Evaluation

- President of the evaluation committee CNRS ofLaRIA (Amiens) 2005 (Y. Métivier)
- Expert for the recruiting committee of a Senior Lecturer in Applied Mathematics, at the university of Linköping, Sweden, 2006 (M. Bousquet-Mélou)
- Expert for the recruiting committee of a Full Professor in Computer Science at the university of Tufts, USA, 2008 (C. Gavoille)
- Expert for 5 propositions of "grant" (Canada - 2, USA, New-Zealand, United Kingdom) - (A. Zvonkine)
- Expert for 4 propositions of "grant" (Israel - 3, Switzerland - 1) - (C. Gavoille)
- Expert for the project ECOS-Sud, 2007 (E. Sopena)
- Expert for the AERES (doctoral school), 2009 (E. Sopena)
- Expert for the program ARPEGE of the ANR 2009 (O. Beaumont)
- Expert for the programme BLANC 2009 (C. Gavoille)

2.9.5 Rapporteur d’HDR ou de thèse étrangères

- William James (Université de Melbourne ; dir. Anthony Guttmann et Xavier Viennot ; 2006, rapporteur) (M. Bousquet-Mélou)
- Amanda Montejano Cantoral (UPC Barcelone ; dir. Oriol Serra ; 2009, rapporteur) (E. Sopena)
- Javier Barajas (UPC Barcelone ; dir. Oriol Serra ; 2007, rapporteur) (E. Sopena)
- Ittai Ibrahim (Hebrew University of Jerusalem, 2009, rapporteur) (C. Gavoille)
- Morgan Seton, 12/2008, Université de la Méditerranée, Luminy, rapporteur (C. Gavoille)
- Swagata Mandal, 2007, Vidyasagar University, Midnapore, India, rapporteur (C. Gavoille)
- Donglin Xia, 04/2007, Arizona State University, USA, rapporteur (C. Gavoille)
- Andrew Twigg, 10/2006, Computer Laboratory, Cambridge University, UK, rapporteur (C. Gavoille)
- Feng Feng, 7/2006, School of Civil & Environmental Engineering Nanyang Technological University, Singapour, rapporteur (C. Gavoille)
- Domenico Mango, 01/2006, Université de L’Aquila, Italie, rapporteur (C. Gavoille)
- Amel Kaouche (rapporteur, thèse, Université du Québec à Montréal, Avril 09) (X. Viennot)
2.10 Annexe B: Jurys

2.10.1 Habilitations (but LaBRI)
- Franck Butelle (Paris 13, 2007) (Y. Métivier rapporteur)
- Nicolas Thiéry (Mathématiques, Paris 11, 2008) (M. Bousquet-Mélou)
- Jean Mairesse (LIAFA, Université Paris 7, 2006) (M. Bousquet-Mélou)
- Frédérique Bassino (Marne-la-Vallée, 2005) (M. Bousquet-Mélou)
- Gilles Schaeffer (Bordeaux, 2005) (M. Bousquet-Mélou)
- Ioan Todinca (Université d'Orléan, 2006) (C. Gavoille)

2.10.2 Thesis (but LaBRI)
- Nicolas Baudru (Amiens, 2005) (Y. Métivier, rapporteur)
- Laurence Pilard (Orsay, 2005) (Y. Métivier, rapporteur)
- Stéphane Devismes (Amiens, 2006) (Y. Métivier, rapporteur)
- Christian Boulignier (Amiens, 2007) (Y. Métivier, rapporteur)
- Antoine Gaillard (Palaiseau, 2009) (Y. Métivier, rapporteur)
- Patricio Reyes, 08/2008, Université Nice Sophia-Antipolis, rapporteur-président (C. Gavoille)
- Eric Fusy (école Polytechnique; dir. Gilles Schaeffer, 2007; rapporteur) (M. Bousquet-Mélou)
- Eric Duchêne (Université Joseph Fourier; dir. Sylvain Gravier; 2006, rapporteur) (E. Sopena)
- Olivier Mallet (LIAFA, Université Paris 7; dir. Jeremy Lovejoy, 2008; rapporteur) (M. Bousquet-Mélou)
- Jean-François Culus (Université Toulouse - le Mirail; dir. Louis Ferré et Bertrand Jouve; 2005, rapporteur) (E. Sopena)
- Léa Cartier (Université Joseph Fourier; dir. Denise Grenier et Charles Payan; 2008, rapporteur) (E. Sopena)
- Julien Fayolle (Université Paris 6, LIP6, 2006; rapporteur) JF Marckert
- Paul Zinn-Justin (rapporteur, Habilitation en Physique Théorique, Univ. Paris 6, Déc 08) (X. Viennot)
- Anissee Kasraoui (rapporteur, thèse, Univ. Lyon, 2009) (X. Viennot)
- Eric Fekete (Université de Versailles 2007) JF Marckert
- Jean-Maxime Labarbe (Université de Versailles 2008) JF Marckert
- Elahe Zohoorian-Azad (IECN, université Nancy 1, 2007) JF Marckert
- Joyce El Haddad (dir. Serge Haddad; Université Paris-Dauphine ; 2005) (C. Johnen)
- Jean Creignou (Université Bordeaux 1, mathématiques; dir. Christine Bachoc, 2008) (M. Bousquet-Mélou)
- Thimou N’Takpé (LORIA, Université de Nancy 1; dir. Jens Gustedt et Emmanuel Jeannot ; 2008) (O. Beaumont)
- Daouda Traore (LIG, ENSIMAG; dir. Jean-Louis Roch et Denis Trystram ; 2008) (O. Beaumont)
- Frédéric Ferchaud, 12/2006, Brétigny/Orge, Eurocontrol (C. Gavoille)

2.11 Annexe C: Collaborations

2.11.1 Conventions or international cooperations
- PICS 3184; Université du Québec à Montréal (Canada); 2005-2007
- Multicomputing; Programme “FitScience” (France-Israël); 2008-2010
2.11.2 Joint publications

- I. Abraham, D. Malhki, N. Nisan, A. Goldberg; Microsoft (Silicon Valley, USA); co-publication
- D. Andrew; Cambridge University (UK); co-publication
- N. Bergeron; York University (Canada); co-publication
- L. Carter, J. Ferrante; University of California at San Diego (Etats-Unis); co-publication
- H. Casanova; University of Hawai at Manoa (Etats-Unis); co-publication
- F. Dragan; Kent University (USA); co-publication
- L. Higham; University of Calgary (Canada); co-publication
- G. Jones; Université de Southampton (Grande Bretagne); co-publication
- H. Kacem, M. Jmaiel; Ecole nationale d’ingénieurs de Sfax (Tunisie); co-publication
- A. Kosowski, L. Kuszner; Gdansk University of Technology (Pologne); co-publication
- Z. Lotker; Ben Gurion University (Israël); co-publication
- E. Macajova, M. Skoviera; Comenius University (Slovaquie); co-publication
- M. Markiewicz; University of Gdansk (Pologne); co-publication
- A. Mazurkiewicz; Institute of computer science of PAS (Pologne); co-publication
- M. Mishna; Simon Fraser University (Canada); co-publication
- M. Nehez; Slovak University of Technology (Slovaquie); co-publication
- J. Nesetril; Charles University (République Tchèque); co-publication
- A. Pelc; Quebec University en Outaouais (Canada); co-publication
- D. Peleg; Weizmann Institute (Israël); co-publication
- N. Santoro; Carleton university (Canada); co-publication
- G. Shabat; Université de Moscou (Russie); co-publication
- M. Thorup; AT&T Labs - Research; co-publication
- G. Tel; Université Utrecht (Pays-Bas); co-publication
- W. Wang; Zhejiang Normal University (Chine); co-publication
- X. Zhu; Yat-sen University (Taiwan); co-publication

2.11.3 Others

- R. Weismantel; Magdeburg University (Allemagne)
- J.H. Kwak; Université de Pohang (Corée du Sud)

2.11.4 Guests

- M. Albert; Otago University (New-Zealand); 2008 (1 month)
- N. Bergeron; York University (Canada); 2009 (1 month)
- O.V. Borodin; Institute of Mathematics and Novosibirsk State University (Russie); 2009 (6 months)
- C. Cooper; King’s College London (Royaume-Uni); 2005 (1 month), 2006 (1 month), 2007 (1 month), 2008 (1 month)
- J. Czyzowicz; Université de Québec à Hull (Canada); 2007 (1 month)
- S. Das; ETH Zurich (Suisse); 2008 (1 month)
- N. Egemen; Université Brunel (Royaume-Uni); 2006 (1 month)
- M. Elkin; Université Ben-Gurion (Israël); 2008 (1 month)
- R. Elsaesser; Université de Paderborn (Allemagne); 2007 (1 month)
- L. Gasieniec; Université de Liverpool (Royaume-Uni) 2006 (2 months), 2007 (1 month), 2009 (1 month)
- G. Hahn; Université de Montréal (Canada); 2005 (1 month), 2007 (1 month), 2008 (1 month)
- C. Hanusa; New-York University (Etats-Unis); 2006 (1 month)
- M. Jmaiel; Ecole nationale d’ingénieurs de Sfax (Tunisie); 2008 (1 month)
- H. Kacem; Ecole nationale d’ingénieurs de Sfax (Tunisie); 2008 (1 month)
- T. Kaiser; University of West Bohemia (République Tchèque); 2006 (Postdoc 1 an)
2.11.5 Invitations

- Mireille Bousquet-Mélou : Institut Mittag-Leffler (Suède); 2005 (3 months)
- " : MIT (Etats-Unis); 2007 (1 week)
- " : Centre de Recerca Matemàtica (Barcelone); 2007 (2 months)
- " : Simon Fraser University (Canada); 2008 (2 weeks)
- Cyril Gavoille : Hebrew University of Jerusalem (Israël); 2006 (2 weeks)
- " : Weizmann Institute (Israël); 2005 (1 week), 2008 (1 week), 2009 (1 week)
- David Ilcinkas : University of Liverpool (Royaume-Uni); 2008 (1 week)
- " : Université du Québec en Outaouais (Canada); 2009 (1 week)
- " : Université d’Ottawa et Carleton University (Canada); 2009 (1 week)
- Colette Johnen : University of Calgary (Canada); 2006 (1 month)
- " : University of Calgary (Canada); 2007 (1 month)
- Yvan Le Borgne : International Institut for Mathematical Physics (Autriche); 2008 (2 weeks)
- " : Université d’Erlangen (Allemagne); 2005 (5.5 months)
- Jean François Marckert : Centre de Recerca Matematica (Espagne); 2007 (3 months)
- " : ESI (Autriche); 2008 (2 week)
- M. Montassier : Comenius University (Slovaquie); 2005 (1 month)
- " : Sun Yat-sen University (Taiwan); 2008 (2 weeks), 2009 (2 weeks)
- " : University of Ilmenau (Allemagne); 2008 (1 month)
- Arnaud Pécher : Magdeburg University (Allemagne); 2005 (1 month)
- " : Sun Yat-sen University (Taiwan); 2007 (2 weeks), 2008 (2 weeks), 2009 (2 weeks)
- André Raspaud : Sun Yat-sen University (Taiwan); 2006 (3 weeks), 2007 (3 weeks), 2008 (2 weeks)
- Xavier Viennot : Université de Reykjavik (Islande); 2005 (1 month)
- " : Institut Mittag-Leffler (Suède); 2005 (1 month)
- " : Université du Québec à Montréal (Canada); 2006 (1 month), 2007 (1 month), 2008 (1 month)
- " : Max Planck Institute(Allemagne); 2007 (1 month)
APPENDIX – COMBALGO

– “ : Académie Suisse à Bâle (Suisse) ; 2007 (1 month)
– “ : Isaac Newton Institute Cambridge (Royaume-Uni) ; 2008 (1 month)
– “ : Erwin Schrödinger Institute for Mathematical Physics (Autriche) ; 2008 (1 month)
– “ : Universités de Porto et de Coimbra (Portugal) ; 2008 (1 month)
– “ : Universités de Porto et de Lisbonne (Portugal) ; 2008 (1 month)
– Alexandre Zvonkine : Université Indépendante de Moscou (Russie) ; 2006 (2 weeks)
– “ : Hebrew University of Jerusalem (Israël) ; 2007 (3 weeks)
– “ : Université du Québec à Montréal (Canada) ; 2007 (2 weeks)

2.12 Annexe D: Contracts and valorisation

2.12.1 Institutional contracts
– A3 ; ANR Blanc ; 2009-2012
– ALADDIN ; ANR Blanc ; 2008-2011
– ALPAGE ; ANR Masses de données ; 2005-2008
– GéoComp ; ACI Masses de données ; 2005-2007
– IDEA ; ANR Blanc ; 2009-2011
– MARS ; ANR Blanc ; 2007-2009
– SADA ; ANR Blanc ; 2005-2008
– USS-SIMGRID ; ANR Calcul intensif ; 2008-2011

2.12.2 Industrial contracts
– Alcatel-Lucent-Bell ; Compact Routing Scheme in Dynamic Networks ; 2009-2010

2.13 Annexe E: Thesis and HDR of the team

2.13.1 Habilitations
– P. Duchon, HDR, Université Bordeaux 1, Combinatoire des configurations de boucles compactes, novembre 2008
– C. Johnen, HDR, Université Paris-Sud, Quelques contributions à l’auto-stabilisation, novembre 2007
– A. Pécher (dir : A. Raspaud), HDR, Université Bordeaux 1, Des multiples facettes des graphes circulants, octobre 2008

2.13.2 Thesis
– S. Abbas (co-dir : A. Zemmari), Doctorat d’Informatique, Université Bordeaux 1, Distributed Calculations using Mobile Agents, Décembre 2006.
– P. Auillans, Doctorat d’Informatique, Université Bordeaux 1, Modélisation de réseaux sémantiques par des hypergraphes et applications, février 2005.
– O. Bernardi (dir : M. Bousquet-Mélou), Doctorat d’Informatique, Université Bordeaux 1, Combinatorics of maps and the Tutte polynomial, septembre 2006.
– J. Chalopin (dir : Y. Métivier), Doctorat d’Informatique, Université Bordeaux 1, Algorithmique distribuée, calculs locaux dans les graphes et homomorphismes de graphes, novembre 2006
- B. Derbel (co-dir : Y. Métivier), Doctorat d’Informatique, Université Bordeaux 1, local aspects in distributed computing, décembre 2006.
- M. Hosseini Dolama (dir : E. Sopena), Doctorat d’informatique, Université Bordeaux 1, Contribution à l’étude de quelques problèmes de colorations de graphes, février 2005.
- M. Montassier (dir : A. Raspaud), Doctorat d’informatique, Université Bordeaux 1, Colorations de graphes sous contraintes et Conception de réseaux embarqués tolérants aux pannes, novembre 2005.
- P. Ochem (dir : E. Sopena), Doctorat d’informatique, Université Bordeaux 1, Graph colorings and combinatorics on words, novembre 2005.
- R. Ossamy (dir. Y. Métivier), Doctorat d’informatique, Université Bordeaux 1, An algorithmic and computational approach to local computations, décembre 2005.
- L. Esperet (dir : A. Raspaud), Doctorat d’informatique, Université Bordeaux 1, Distance-two colorings of graphs, mai 2008.
- D. Goncalves (dir : A. Raspaud), Doctorat d’informatique, Université Bordeaux 1, Etude de différents problèmes de partition de graphes, novembre 2006.
Team

Image and Sound
(IS)

Head: H. NICOLAS

Activities:

• Theme *Structuring and analysis of images*
  Head: A. BRAQUELAIRE
  Keywords: Segmentation and Image Analysis, Discrete Topology, Geometry, Representation, Extraction of characteristics, Medical images, Surface reconstruction

• Theme *3D modelling, visualisation and interaction*
  Head: P. GUITTON
  Keywords: Modeling, Acquisition, Augmented Reality, 3D Interaction, Virtual Reality, Rendering

• Theme *Video analysis and indexing*
  Head: J. BENOIS-PINEAU
  Keywords: Video indexing, Spatio-temporal Segmentation, Video Objects, Analysis, Video-surveillance, Trajectories, Scalability, Compressed streams

• Theme *Modelling of sound and music*
  Head: M. DE SAINTE-CATHERINE
  Keywords: Analysis, Representation and structuring, Sonor and Music information, Analysis/Synthesis of audio scenes, Estimation of the musical similarity, Music and visual interactions

• Team-Project *IPARLA*
  Head: P. GUITTON
  Keywords: Modeling, Acquisition, Augmented Reality, 3D Interaction, Virtual Reality, Rendering
CHAPTER 3. TEAM IS

3.1 Members
(at 31st of August 2009)

T1: Theme Structuring and analysis of images
T2: Theme 3D modelling, visualisation and interaction
T3: Theme Video analysis and indexing
T4: Theme Modelling of sound and music
E5: Team-Project IPARLA

3.1.1 Permanent faculty

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<td>Vice-Pr. CEVU Bordeaux 1</td>
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<td>Braquelaire, A.</td>
<td>PR U. Bordeaux 1</td>
<td>×</td>
<td>Dir. adjoint LaBRI</td>
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<td>Dir. adjoint LaBRI (2005-2006)</td>
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<td>Domenger, J.-P.</td>
<td>PR U. Bordeaux 1</td>
<td>×</td>
<td>Dir. MIAGE</td>
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<td>Mansencal, B.</td>
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Total ETPC²: 15 (PR: 8 MCF: 12 CR: 4 IGR: 1)

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1. Restricted to (vice-)presidents and (deputy-)directors of school, laboratory, department, and of international relationships.
2. Equivalent Temps Plein Chercheur.
### 3.1.2 Temporary personnel

<table>
<thead>
<tr>
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**Total** ETPC: 25.7

### 3.1.3 Personnel under industrial contract

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**Total** ETPC: 4.5

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1. Prorata temporis.
3.2 Research summary

The general goal of the research group is to develop methods for improving the acquisition, analysis, modeling, synthesis, and interaction with data that could be labeled as multimedia data. The data manipulated by the group represent a wide spectrum from sound to 2-D or 3-D imaging and video. In order to accomplish this task, the group is divided into four themes. Generally speaking, one can consider each of these themes to be particularly interested in the following types of data: sound, 2-D/3-D images, video, and 3-D data for virtual reality. However, this division is not strict, and concrete collaborations between the themes occur frequently and naturally. The scientific issues that are encountered vary with the type of data and the desired applications. Despite this fact, those issues have many fundamental similarities, in particular in the domains of modeling, synthesis or of rendering and indexing which are some of the keywords of the main research interests of the group.

Generally speaking, data modeling consists of obtaining an accurate model using both application and acquisition constraints and intrinsic characteristics. For instance, when analyzing a music score, modeling the sound signal requires taking into account musical criteria such as melody or rhythm, and allows us to resynthesize the sound while still keeping the option of interacting with the signal. In the video domain, we seek to segment moving objects, to analyze their behavior, to partition and summarize the contents in different resolutions of the flow in order to deduce semantic information about the video contents, or with the purpose of indexing. In 3-D imaging, extending two-dimensional models and taking into account acquisition conditions (tomography and medical imaging) allow the segmentation of 3-D images. Modeling and visualizing data from clouds of points from 3-D digitizing or video flows (form reconstruction) allows us to extract a numeric representation adapted to the application in question thanks to often very complex 3-D models.

Quantitatively, some numbers give an idea of the results of the work done by the group between 2005 and 2008. First, note that the group currently consists of 24 permanent researchers or teachers/researchers as well as around 20 non-permanents. A main objective of the group consists of developing its research activities in the context of collaborations with other academics, or with industry. The concrete results of this objective are around 15 ANR projects, around 15 industry collaborations, in particular in the form of CIFRE PhD scholarship, or internationally as collaborations in various networks, European projects, joint theses advising, many visits to foreign laboratories or inversely by foreign visitors to our group. Finally, the group actively participates in editorial committees of journals and in the organization and running of various conferences. Group members have also applied for patents jointly with three different companies. The group has generated 23 PhDs, 3 "habilitations" often as external collaborations. The following sections explain more in detail the scientific progress realized by each of the four themes of our group.

3.2.1 Theme: Analysis and Indexing of Video

Keywords: space-time extraction of hints from video flow: object, motion, events, scalable partitioning and indexing in the compressed domain, classification and learning, tracking of trajectories, video surveillance.

Scientific context

With increasing availability of video-acquisition devices: button cameras, webcams, high-definition cameras, increased network bandwidth and storage capacity, digital video with its masses of data requires intelligent access and structuring and research according to contents. In this context, two aspects are developed: analysis and indexing. The analysis consists of extracting so-called low-level hints, such as local/global motion, moving zones, and characteristic points. The indexing itself uses elements of analysis to identify significant objects and events in the video flow, to search for similar video segments in order to transform (summarize) a document, or in order to look for similar video segments in a database. During the past four years, this theme has
conducted research in two different directions: primary video-indexing paradigms, and analysis of videos for applications in video surveillance and medical imaging.

**Primary indexing paradigms: analysis and indexing of compressed videos**

A large number of videos are stored and available only in compressed form. This requires the use of methods using primary hints such as fields of motion and transformation coefficients used by different compression standards. We have developed a set of tools addressing fundamental task of video compression such as characterizing the motions of the camera, detection of planes for montage, and extraction of faces. These tools build on motion analysis and on supervised and unsupervised statistic learning, and have been deployed in the context of the project ARGOS-TECHNOVISION 2005-2007, and in the context of the international campaign TREC Video 2005-2008. This research has been coordinated at the European level by our participation in the European action COST292 2005-2008. We have organized the action Indexing and Search of Multimedia Information of the CNRS GDR ISIS (2007-2009), and we have created the French consortium IRIM in order to manage the tasks of the TREC Video Campaign 2008, 2009. The new generation standards such as H264 and JPEG2000 are scalable. They support different resolutions of the same video contents in a single compressed flow. In the context of the ANR project MDCA ICOS-HD 2007-2011, we have developed tools for scalable analysis and indexing adapting segmentation of video into objects and characterization of movement to the resolution. We have realized an estimation of the trajectories of moving objects in an H264 flow using only movement vectors present in the flow, and we obtained pseudo-3-D trajectories that are quite reliable on different types of videos. The JPEG2000 standard does not contain primary hints related to motion. For that reason, we have developed a motion estimator that works directly on the pyramid of wavelets, and we have proposed a detailed hierarchical segmentation of Markovian adjustments. We have also proposed a per-object statistical descriptor, and we have produced an annotated HD video corpus in order to test these methods. This corpus has been deposited at InterDeposit/APP and will soon be available on the website of the OpenVido.org project run by the university of North Carolina, USA. Learning methods for searching and indexing images are developed in collaboration with the theme "Image Structuring and Analysis" in the context of the European project PI Xmedia 2006-2010.

**Analysis of sequences of video-surveillance and monitoring**

This activity is concerned with the detection and analysis of abnormal events in the context of road traffic, with analysis of customer behavior, with tracking of objects in a multi-camera environment, and with the extraction of objects in videos coming from cameras carried by patience for monitoring dementia. We have developed a method for multi-resolution tracking based on particle filtering using multi-camera flows, a method allowing either the interpretation of behavior of objects in motion in a static-camera environment, or the extraction of objects when cameras are carried and subject to considerable motion and when the images are of low quality. This activity is being developed in the context of one CIFRE and one MENRT PhD scholarship, of a PEPS project that followed an ANR project (IMMED), a joint scholarship with PKKU (Budapest) and a BDI scholarship.

**Analysis of motion in bio-medical images**

In collaboration with teh IMF, we have created a method for modeling of motion in MRI sequences using analysis of main components. This method has been used for aligning temperature charts in real time. A new PhD thesis started in 2008 in collaboration with the IMF, the subject of which is reliable estimation of cardiac motion.

3.2.2 Theme : 3-D Modeling, Visualization and Interaction

**Keywords**: Acquisition, modeling, rendering, interaction, virtual reality, augmented reality.
CHAPTER 3. TEAM IS

Scientific context

From the beginning of the computer era, there have been great evolution, but the human operator is remained stationary behind his keyboard and screen. Since not too long ago, a revolution has begun with the availability of light-weight and independent computers (telephones, PDAs, game consoles, UMPC) that make the users mobile. This theme is particularly interested in this new family of users (professional, or wide-audience), in order to follow the technological evolution and to create new usages for 3-D images. We are not developing ad-hoc solutions adapted to this or that particular type of mobile equipment, but we are instead imagining global approaches allowing similar use on all such equipment. It might for instance be an engineer sometimes working on a PC in an office, sometimes in a virtual-reality room with cluster, and sometimes in an airport with an UMPC. Another example would be managing a disaster situation with staff using mobile equipment, equipment in a vehicle for coordination close to the disaster area, and a central facility in a remote control room. In order to homogenize the use in these different situations, it is necessary to handle each link in the processing chain: acquisition/modeling, modeling/rendering, and 3-D interaction. The rest of this text presents some important activities in each of these domains, both in the context of fundamental upstream research in order to design methods and data structures adapted to the problem, but also in the context of more applied research in order to validate the results in the form of significant demos.

Acquisition/Modeling

Digital terrain model: In order to create enriched MNTs, we have created a method allowing the reconstructions of reliefs from level lines extracted from topographic maps. These results have been implemented in a freely-available software platform (AutoDEM).

Modeling based on sketching: This is an interpreter of 2-D traces with the purpose of creating 3-D volumes. We have proposed improvements in the creating of the forms (skeleton extraction, use of implicit surfaces), and in the editing of these forms.

Acquisition from video flows: We have improved on algorithms resulting from the Grimage project (Grenoble) and we have designed new algorithms for extracting information and 3-D models in real time from silhouettes of video flows. This activity is conducted in particular in the context of the Dalia ANR project, where we intend to develop a grid of heterogeneous interactions, and also in the context of a CIFRE PhD scholarship in order to design a method for reconstructing buildings from videos taken by a drone.

Topology-based modeling: In collaboration with the theme "Image Structuring and Analysis", we have developed a processing chain capable of all steps from the acquisition from a 3-D scanner to 3-D printing with intermediate steps for alignment and integration of views. This work has as an objective the total control of errors, for which we use an adaptation of Euclidean geometry to discrete objects obtained from objects.

Modeling: Many of our activities have concentrated on managing very large 3-D models, often without any structure such as clouds of point from 3-D capturing. Among our results are: The VS-tree, an optimal data structure combining the advantages of 3-D (coarse level) and 2-D (precise level) decomposition, an interactive out-of-memory texturing algorithm, an efficient approximation method for subdivision surfaces, tools for the edition of appearance based on free deformations, and techniques for dynamically refining arbitrary topological meshes on the GPU.

Modeling/Rendering:

To address the objective of homogeneous use, we suggest a client-server based software architecture named Elkano, which integrates a large number of our theoretical results. Elkano can be executed on a telephone, a workstation, or a cluster, and implements progressive and adaptive rendering schemes (as a function of available computer power) based on streaming (geometry, texture, appearance).

Realistic rendering: in order that photo-realistic rendering algorithms be usable to non computer scientists (such as artists), we have developed a number of techniques by creating a new BRDF model using sketching. We have also produced new BTF compression schemes particu-
larly adapted to the GPU, a volume representation for entering and editing indirect lighting, and algorithms for rendering soft shadows in real time.

**Expressive rendering** : in various contexts (ARC INRIA MIRO, ANR Animare, the Japanese company OLM), we have obtained several noticeable results : a stroke-based rendering method for urban scenes, a new form descriptor (with obvious relief) for efficiently representing forms using shadowing, diffusion curves for facilitating complex graduated shadings.

**Interaction**

To address the goal of homogeneous use, we propose a method for positioning cameras named Navidget. This method allows the user to define a viewpoint in a precise and easy way thanks to 2-D controls, and this either on a telephone with a stylus in front of a large screen, or using a finger on a tactile screen. In collaboration with colleagues at ESTIA, we have created techniques for assembling components using tangible interfaces in the context of geology (GeoTUI) and archeology (ArcheoTUI, 3-D fragment puzzles). Finally, we are also working on increasing interaction capacities on tactile surfaces made popular by the success of the Iphone which today are often 2D and single-point. We are developing new techniques for editing, deform, and move 3-D objects, in particular in the context of the SOUL project (AESE).

**Immersive environments** : This activity which started slightly before the evaluation period has continued : the CAT, a device with 6 degrees of freedom for 3-D navigation and control. We also mention an interface for collaborative work around the Illusion Hole, and joint work with the "Sound and Music Modeling" theme the purpose of which is the creation of 3-D interaction for the control of the performance of pieces of music.

**Mobile environments** : We obtained results with existing devices : for visualizing panoramas, for quickly accessing a point in the space, or with new functionalities : 3-D navigation and manipulation with the help of a camera, elastic stylus control, creation of a joystick for a cellphone with 3 degrees of freedom.

3.2.3 Theme MSM : "Sound and Music Modeling"

**MSM Theme : Sound and Music Modeling**

**Keywords** : Analysis, representation and structuring of sonor and music information, analysis/synthesis of audio scenes, estimation of the musical similarity, music and visual interaction.

**Presentation** The main aim of the researches conducted by the Sound and Music Modeling theme of the Image and Sound team of the LaBRI is to develop models for sound, music, and scores that allow various interactions, possibly in real time. These models could lead to new instruments allowing the interaction with the musical media, from the spatialization of the sound sources of the piece up to the interpretation of written pieces. The applications of theses researches are done in close collaboration with the SCRIME and are oriented mainly towards musical creation and pedagogy.

In a general manner, the research in computer music is split in two rather disjoint domains : a symbolic domain linked to the modeling of musical pieces and rules, in order to ease musical analysis and composition ; and a physical domain linked to the analysis, processing, and synthesis of sounds.

Our subjects of interest range from sound representations close to perception up to musical representations related to writing, going through music information retrieval. Regarding sound modeling, we focus on musical sounds and keep the model close to the perception. Thus, we model sounds at the receptor (listener), rather than at the emitter (unlike physical models for example). This choice leads us to work in close collaboration with psychoacousticians, and in spectral representation. In addition to the model, we want a full analysis / synthesis chain, unlike classic research in music indexing for example, where only the analysis step matters – without any expected modification of the obtained parameters for the resynthesis of a transformed sound.
We focus on algorithms and data structures. Even if a strong knowledge in signal processing and probabilities is required, we are convinced that we will arrive to problems more related to algorithmics and combinatorics.

From the sound signal, we accurately estimate the parameters of the spectral components, and we reconstruct their temporal evolutions thanks to a mechanism of tracking using prediction.

This allows us to efficiently resynthesize the musical sound, while being able to interact with it, that is, to modify it in real time—while listening—perceptual parameters such as the pitch, intensity, timbre, duration, or spatial location of the sound entities present in the musical mix.

For audio signals, we are also interested in retrieving music information. A new working group of the LaBRI proposes to develop systems for the estimation of music similarity, based on various criteria such as the melody, harmony, tonality, rhythm, etc. This research group is composed of members of the Image and Sound team (Sound and Music Modeling theme) together with members of the team dealing with Models and Algorithms for Bioinformatics and Information Visualization. The first results of this new project are mainly for melodic similarity from a symbolic representation of music. Local alignment allows the comparison of sequences while stressing approximate similarities, even on parts of the music. The adaptation of such algorithms allowed the development of a system for the estimation of the melodic similarity, among the most precise systems of the Music Information Retrieval Evaluation eXchange (MIREX) contest. An algorithmic improvement for real-time interaction was also proposed. The extension of this system to the polyphonic case raised the problem of the representation of musical pieces where several notes can be played simultaneously. The possibility to revert to the monophonic case—based on tonal information—has been studied. Taking into account the whole tonal information should allow us to enhance the precision of the systems for the estimation of musical similarity, but impose a structuring of the musical information as a tree, thus leading to algorithms for the alignment of tree-like structures. A first study has already shown the interest of such an approach. Several musical applications have already been developed and evaluated: query by humming, query by rhythm, visualization of musical structures, as well as the automatic detection of plagiarisms.

Regarding the symbolic level, our researches deal with the writing of musical pieces and are divided in two main points:

- Development of an editor for interactive scores, powerful and with a graphical user interface of high quality, with the display of a specific notation for microtonality.
- Definition of a model for interactive scores that allow the composer to take into account real-time interactions during the composition process. The interpretation of the music piece is modeled as an optimization problem in a space of possible interpretations limited by the constraints placed by the composer. The interpretation model for the interactive partitions is based on Petri nets, together with a mechanism of constraint perturbation at the execution.

3.2.4 Theme SAI: "Image analysis and structuring"

Keywords: discrete topology, geometry, segmentation, reconstruction, smoothing, extraction of characteristics.

Presentation

Discrete models for digital images. The fundamental research into 2-D image structuring and the applications to image segmentation have resulted in the distribution according to the LGPL license of the GIRL software environment. This environment, dedicated to the structuring and segmentation of 2-D images, has allowed the theme to attack problems in applied research. The contribution of the theme to the European project XMedia are a direct result of the existence of this environment. It is also the basis of industrial collaborations with industry, such as I2S, SFRI, and Cosderma.

During the past four years, in parallel with the development of GIRL, we have worked on the extension of the structuring model to 3-D images. The goal of this model is the segmentation of 3-D images resulting from physical acquisitions. It uses both methods based on volume and methods...
based on surface. Today, such a model is an important technological stake because the quantitative analysis of 3-D images (geometric measures, computed data such as flow, temperature, etc.), is important both in tomography and in medical imaging. In effect, currently available models and tools do not address real problem in a satisfactory manner.

In the domain of discrete geometry, we have continued to study of linear parts of discrete 2-D objects. This fundamental research has, among other things, allowed us to define a new estimator for discrete 2-D tangents which is both precise and asymptotically convergent. In general, geometric characteristics of discrete objects are directly used in image segmentation and analysis (parametrization and conditioning of deformable models, classification).

From acquisition to use. The results obtained have allowed the theme to unite its activities in an ambitious project the goal of which is the complete control, based on a discrete approach, of the entire processing chain from acquisition to reconstruction. One objective is to obtain a reliable measure of the error produced in each link of the chain. In this context, we have worked on discrete techniques for tomographic reconstruction. A collaboration with Teraherz imaging (weakly-ionizing acquisition technique) of the CPMOH (UMR 5798) and the company I2S has been recognized by the the "road of the laser" project and has resulted in a patent application. Using the initial results in 3-D segmentation, we can extract volume zones of interest. On these volumes, our results in discrete geometry supply pertinent geometric descriptors thus allowing the analysis of the zones. At the same time, we have developed techniques for surface reconstruction of the frontier of a volume. These techniques allow us to obtain better measures than traditional techniques (such as the marching cubes) about the surface. In order to experimentally compare our theoretical results to physical reality, we reconstruct our objects using a 3-D printer. The precision of the printer allows us to measure the error between the physical model and the one produced by the processing chain (acquisition, processing, reconstruction). The acquisition of this printer was made possible through the support of the Aquitaine region, of the CNRS, and of the university Bordeaux 1.

The results obtained on the different links of the processing chain have allowed us to establish inter-disciplinary collaborations in the context of medical imaging (INSERM U885, CHU Bordeaux, the company Med-Imaps, the medical departments of Siemens and Philips), and in the context of digital paleontology with the LAPP group of the PACEA laboratory (UMR 5199).

### 3.3 Highlights

[A compléter]

Competitive examination Awards

### 3.4 Visibility

<table>
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3.5 Jurys

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3.6 Collaborations, contracts and valorization

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For world map, see Figure 1.2.

3.7 Thesis and HDR

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## 3.8 Publications of the team IS

### 3.8.1 Summary

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Be reminded that all the publications listed here under the category *Journals* and the vast majority of those listed under the category *Conferences and Books* (and many of those listed under the category *Other*) are publications of Rank A as defined by the AERES. Indeed, it is the team that has chosen the journals and the conferences that are highlighted with the label *Selection* in order to put emphasis on certain publication media, and in no case does this imply the declaration of the complement of this selection as being of lower quality.

### 3.8.2 Journals [ACL]

(journals with editorial board registered by AERES or by international data bases)

**Selection**


Other


BIBLIOGRAPHY – IS


[Ra44] M. Robine, P. Hanna, and M. Lagrange, **Meter class profiles for music similarity and retrieval**, (2009).


### 3.8.3 Conferences [INV, ACTI, ACTN]

(invited conferences, international or national conferences with proceedings)

Selection

( 3DUI, CHI, CVPR, Eurographics, ICASSP, ICCV, ICIP, ICME, ISMAR, ISMIR, JCDL, MICCAI, SIGIR, UIST, VR, SIGGRAPH )


BIBLIOGRAPHY – IS


Invited

(invited speaker in international or national conferences)


**Other**


[Ca28] A. Braquelaire, Representing and segmenting 2d images by means of planar maps with discrete embeddings : From model to applications., in IAPR- Graph Based Representation for Pattern Recognition, vol. LNCS, Springer, 2005, pp. 92–121. [hal-00308355]


[Ca30] H. Brian, P. Depalle, and S. Marchand, Theoretical and practical comparisons of the reassignment method and the derivative method for the estimation of the frequency slope, in IEEE Workshop on Applications of Signal Processing to Audio and Acoustics (WASPAA’09), 2009, p. 4 pages. [hal-00409602]


[Ca34] F. Chevalier, M. Delést, and J.-P. Domenger, A heuristic for the retrieval of objects in low resolution video, in Workshop on Content-Based Multimedia Indexing, vol. 1, LaBRI, 2007, pp. 144–151. [hal-00306683]


[Ca37] A. Clay, E. Delord, N. Couture, and G. Domenger, Augmenting a ballet dance show using the dancer’s emotion : conducting joint research in dance and computer science, in International Conference on Arts and Technology (ArtsIT2009), vol. à paraître, 2009. [hal-00408184]

[Ca38] N. Couture, F. Depaulis, L. Garreau, and J. Legardeur, Skua : a platform based on tangible user interface dedicated to mechanical cad parts assembly, in Virtual Concept 2005, 2005. [hal-00183409]


BIBLIOGRAPHY – IS


[CA80] P. Hanna, M. Robine, and P. Ferraro, Visualisation of musical structure by applying improved editing algorithms, in International Computer Music Conference (ICMC), 2008. [hal-00345346]


[CA92] L. Kabongo, C. Mougénot, P. Desbarats, and E. Dumont, Algorithms comparison in acoustic field simulations for ultrasound hyperthermia, in Summer Computer Simulation Conference (SCSC06), 2006. [hal-00308165]


[CA95] C. Kaes and H. Nicolas, Compressed domain copy detection of scalable svc videos, in CBMI - IEEE, 2009. [hal-00411236]


[CA99] P. KRAEMER and J. BENOIS-PINEAU, Camera motion detection in the rough indexing paradigm, in TREC Video Retrieval Evaluation (TRECVID05), 2005. [hal-00308209]


3.8.4 Books [OS, OV]

(scientific book or chapter)


### 3.8.5 Other publications [ACLN, ASCL, COM, AFF, DO, AP]

(reviues without review process, oral contribution without proceedings, poster, editorial board, registred software, translations, guides and technical reports, intermediate reports for large project)


BIBLIOGRAPHY – IS


[Au66] T. Rocher, M. Robine, and P. Hanna, Amélioration des méthodes d’estimation d’accords et de tonalité depuis une représentation musicale symbolique, in Journées d’Informatique Musicale (JIM), 2009. [hal-00391131]


3.9 Annexe A: Visibility

3.9.1 Editorial board, invited editor
- J. Benoist-Pineau : Signal Processing : Image Communication, Elsevier, Editeur associé ; since 2005
- Sylvain Marchand : Éditeur Associé des IEEE Transactions on Audio, Speech, and Language Processing ; since 2007
- Christophe Schlick : Computer Graphics Forum, since 2005
- Signal Processing : Image Communication 22 (7-8), Editeur invité J. Benoist-Pineau, 2007
- Traitement automatique des langues (TAL) ; Vol 48, n3, Numéro Spécial « Langues des signes » 2007, J. Benoist-Pineau

3.9.2 Steering committee
- Achille Braquelaire : DGCI (Discrete Geometry for Computer Imagery); since 2007
- Myriam Desainte-Catherine : DAFx (International Conference on Digital Audio Effects), since 2007
- Myriam Desainte-Catherine : SMC (International Conference on Sound and Music Computing) ; since 2004
- Pierre Hanna : DAFx (International Conference on Digital Audio Effects), since 2007
- Sylvain Marchand : DAFx (International Conference on Digital Audio Effects); since 2006
- Sylvain Marchand : MMEDIA (International Conference on Advances in Multimedia); 2009
- Marie Beurton-Aimar : GDR STIC SANTE Thème A ; since 2008
- Myriam Desainte-Catherine : JIM (Journées d’Informatique Musicale); since 1994
- Jenny Benoist-Pineau : CBMI ; Atelier IEEE (WorkShop) sur l’indexation multimédia par le contenu; 2009, 2010

3.9.3 Program committee
- Sylvain Marchand : General Chair de DAFx 2007
- Pascal Guitton : The Virtual International Conference; Laval; 2008
- Jenny Benoist-Pineau : CBMI 2007 et 2008 ; co-présidente du comité de programme
- Pascal Barla : NPAR (International Symposium on Non-Photorealistic Animation and Rendering);2008-2009
- Jenny Benoist-Pineau : AMR Adaptive Multimédia Retrieval; 2003 - 2008
- Jenny Benoist-Pineau : ACM Multimedia; 2008
- Jenny Benoist-Pineau : CBMI WorkShop soutenu par IEEE ; 2005 - 2009
- Jenny Benoist-Pineau : CVIR ACM Conference on Visual Information Retrieval ; 2009
- Marie Beurton-Aimar : Workshop on MAS in Biology at the Meso or Macroscopic Scale ; 2008-2009
- N. Couture : VRIC 2008
- Myriam Desainte-Catherine : CIM (Conference on Interdisciplinary Musicology); 2005 et 2009
- Myriam Desainte-Catherine : DAFx (Digital Audio Effects), 2007-2009
- Myriam Desainte-Catherine : ICMC (International Computer Music Conference); 2005 et 2007
- Myriam Desainte-Catherine : SMC (Sound and Music Computing);2005 - 2006
3.9.4 Conference organization

- Jenny Benoist-Pineau : CBMI 2007; présidente du comité d’organisation
- Martin Hachet : ACM VRST 2008; Bordeaux; 2008
- Sylvain Marchand : Chairman DAFx; en 2006; 2007 et 2008
- Sylvain Marchand : Responsable de thème pour International Computer Music Conference (ICMC); en 2005 et 2009
- Jenny Benoist-Pineau; Henri Nicolas : CBMI; 2007; LABRI, France
- Jenny Benoist-Pineau : CBMI; 2009; Crete; (chargée de publicité)
- Sylvain Marchand; Myriam Desainte-Catherine; Pierre Hanna; Robert Strandh : International Conference on Digital Audio Effects (DAFx); 2007
- Robert Strandh : First European Lisp Symposium (ELS2008); mai 2008
- Pascal Guittout : First Sino-French Workshop on Digital Images, Nanjing; 2006;(en collaboration avec S. Donikian, Rennes)
3.9.5 Evaluation

- J. Benois-Pineau : Comité d’évaluation AERES de l’Institut Galilée; 2008
- P. Guitton : Comité d’évaluation du LIRIS; Lyon ; 2006
- P. Guitton : Comité d’évaluation de la Fédération de Recherche "Physique et image de la ville; CNRS, Ecole Centrale, Ecole des Mines, Ecole d’Architecture, LCPC, CSTB; Nantes; 2006
- C. Schlick : Comité d’évaluation du LSII; Strasbourg; 2008
- P. Guitton : Comité scientifique du projet Visitor. Action Marie Curie; Grenoble; 2008
- Jenny Benois-Pineau : Commission Multimédia SDTICE; MEN expert -rapporteur; 1998-2009
- Henri Nicolas : AERES 2008
- Jenny Benois-Pineau : programme franco-brésilien 2007
- Jenny Benois-Pineau : Commission Européenne (DG INFSO); 2005 - 2009
- M. Desainte-Catherine : Comité des experts du Comitado di Indirizzo per la Valutazione della Ricerca en Italie (CIVR; Board of Experts in the data bank of the Italian Ministry of Education; University and Scientific Research (MIUR)); 2004-2009
- Pascal Guitton : Expertise ANR appel « Franco-chinois » 2009

3.10 Annexe B: Jurys

3.10.1 Habilitations (but LaBRI)

- Ph. JOLY (IRIT, Toulouse); 1 decembre 2006; Rapporteur (J. Benois-Pineau)
- D. Coquin (LISTIC Univ. de Savoie); 6 décembre 2007; Rapporteur (J. Benois-Pineau)
- Anne Sédès (Université Paris 8); 25 mai 2007; rapporteur (M. Desainte Catherine)
- P. Chevaillier; (Brest, CERV); 12 décembre 2006; Rapporteur (P. Guitton)
- D. Meneveaux; (Poitiers, SIC); 27 mars 2008; Rapporteur (P. Guitton)
- J. Thollot; (Grenoble, LIG); 24 novembre 2008; Rapporteur (P. Guitton)
- G. Moreau; (Nantes, ECN); 3 juillet 2009; Rapporteur (P. Guitton)
- Laurent Girin (INPG; Université Grenoble); 16 novembre 2005 (M. Desainte Catherine)
- Gérard Assayag (Université Bordeaux 1); 5 juin 2009 (M. Desainte Catherine)
- Nicolas Thiéry (Mathématiques, Paris 11, 2008) (mbm)
- J.M. Hasenfratz; (Grenoble, GRAVIR); 10 octobre 2005 (P. Guitton)
- B. Raffin; (Grenoble, LIG); 3 mars 2009 (P. Guitton)

3.10.2 Thesis (but LaBRI)

- R. COUDRAY; (L3I, La Rochelle); 24 novembre 2005; Rapporteur (J. Benois-Pineau)
- G. JAFFRE; (IRIT, Toulouse); 17 novembre 2005; Rapporteur (J. Benois-Pineau)
- N. GRIRA (INRIA, Rocquencourt), 6 juin 2006; Rapporteur (J. Benois-Pineau)
- F. Gianni, (IRIT, Toulouse), décembre 2007; Rapporteur (J. Benois-Pineau)
APPENDIX – IS

- Th. TOTOZAFINY (ESTIA -LIUPPA, Bayonne), 3 juillet 2007; Rapporteur (J. Benoist-Pineau)
- N. THOME (LIRIS, Lyon) 11 juillet 2007; Rapporteur (J. Benoist-Pineau)
- E. GALMAR (EURECOM, Sophia-Antipolis), 23 juin 2008; Rapporteur (J. Benoist-Pineau)
- H. GOE (GIPSA-LAB - INA), 25 mai 2009, Rapporteur (J. Benoist-Pineau)
- M. DRUON, (XLIM-SIC, Poitiers), 11 février 2009, Rapporteur (J. Benoist-Pineau)
- E. DUMONT, (EURECOM, Sophia-Antipolis), 4 février 2009; Rapporteur (J. Benoist-Pineau)
- F. EL BAF ( MIA, La Rochelle), juin 2009; Rapporteur (J. Benoist-Pineau)
- A. Woodward, PhD. (The University of Auckland); juin 2009 Rapporteur (J. Benoist-Pineau)
- J. Royan; (Rennes, FT R&D); 27 janvier 2005; Rapporteur (P. Guitton)
- J. Vedrigo; (Grenoble, ID); 16 juin 2005; Rapporteur (P. Guitton)
- S. Madougou; (Orléans, LIFO); 12 décembre 2005; Rapporteur (P. Guitton)
- R. Crespin; (Lyon, LIRIS); 3 avril 2006; Rapporteur (P. Guitton)
- L. Pereira; (Nancy, LORIA); 9 mai 2006; Rapporteur (P. Guitton)
- J.M. Souffeze (Rennes, IRISA); 4 juillet 2006; Rapporteur (P. Guitton)
- P. Barla; (Grenoble, GRAVIR); 12 novembre 2006; Rapporteur (P. Guitton)
- C. Cassagnabère; (Calais, LIL); 29 janvier 2007; Rapporteur (P. Guitton)
- T. Di Giacomo; (Genève (Suisse), MIRALab); 26 février 2007; Rapporteur (P. Guitton)
- C. Menier; (Grenoble, LIG); 19 avril 2007; Rapporteur (P. Guitton)
- D. Weining; (Nancy, LORIA); 4 mai 2007; Rapporteur (P. Guitton)
- S. Marchesin; (Strasbourg, LSIT); 12 juillet 2007; Rapporteur (P. Guitton)
- R. Cavagna; (Rennes, IRISA); 20 décembre 2007; Rapporteur (P. Guitton)
- G. Sourimant (Rennes, IRISA); 20 décembre 2007; Rapporteur et Président (P. Guitton)
- C. Dehais; (Toulouse, IRIT); 21 mai 2008; Rapporteur (P. Guitton)
- S. Gerbaud; (Rennes, IRISA); 1 octobre 2008; Rapporteur (P. Guitton)
- M. Dodo; (Toulouse, IRIT); 6 novembre 2008; Rapporteur (P. Guitton)
- D. Van Der Haeghe; (Grenoble, LIG); 24 novembre 2008; Rapporteur (P. Guitton)
- T. Jehaes; (Hasselt (Belgique), EDM); 22 février 2008; Rapporteur (P. Guitton)
- S. Horna; (Poitiers, SIC); 27 novembre 2008; Rapporteur (P. Guitton)
- V. Vivianloc; (Toulouse, IRIT); 18 décembre 2008; Rapporteur (P. Guitton)
- W. Abou Moussa; (Toulouse, IRIT); 18 décembre 2008; Rapporteur (P. Guitton)
- P. Qing; (Lille, LIFL); 19 décembre 2008; Rapporteur (P. Guitton)
- U. Zaldivar Colado; (Versailles, LISV); 24 juin 2009; Rapporteur (P. Guitton)
- Florent Duguet; (INRIA, Sophia-Antipolis); juin 2005; Rapporteur (Christophe Schlick)
- Ileana Anca Alexe; (IRIT, Toulouse); décembre 2005; Rapporteur (Christophe Schlick)
- Basile Sauvage; (LMC, Grenoble); décembre 2005, Rapporteur (Christophe Schlick)
- Marie Samozino; (INRIA, Sophia-Antipolis); juillet 2007; Rapporteur (Christophe Schlick)
- Dominique Sobczyk; (LIA, Paris); décembre 2007; Rapporteur (Christophe Schlick)
- Emmanuelle Darles; (XLIM, Limoges); octobre 2008; Rapporteur (Christophe Schlick)
- F. Manerba; (université de Brescia, Italie); 5 novembre 2005 (J. Benoist-Pineau)
- Ch. MUGENOT; (l’IMF); 12 décembre 2005 (J. Benoist-Pineau)
- K. Dahan (Université Paris 8); 20 décembre 2007 (J. Benoist-Pineau)
- A. BUGEAU (INRIA, centre de Rennes); 20 décembre 2007 (J. Benoist-Pineau)
- M. FONTMARTY, (UPS Toulouse, LAAS) 20 décembre 2008 (J. Benoist-Pineau)
- V. GARCIA ( I3S, U. Nice, Sophia Antipolis)11 décembre 2008;Présidente (J. Benoist-Pineau)
- A. WOODWARD ( U. Auckland, Nouvelle Zélande) juin 2009;Rapporteur (J. Benoist-Pineau)
- Desmeulles Gireg; Université Bretagne occidentale; décembre 2006 (Marie Beurton-Aimar)
- Bassano Vincent; Université d’Evry; décembre 2006 (Marie Beurton-Aimar)
- Druelle Johan; Université Lyon; juin 2008 (Marie Beurton-Aimar)
- Glisse Jérôme; Université Jussieu Paris 6; janvier 2009 (Marie Beurton-Aimar)
- K. Dahan (Université Paris 8); 20 juin 2005; rapporteur (M. Desainte Catherine)
- Miguel A. Alonso Arevalo (ENST Paris); 13 novembre 2006 (M. Desainte Catherine)
3.10.3 Concours

- Marie Beurton-Aimar : Jury IR CNRS; 2007
- X. Granier : Jury CR INRIA; Lille; 2007
- Nadine Couture : Jury Enseignant-Chercheur ESTIA; Biarritz; 1999-2004
- P. Guitton : Jury CR INRIA; Rennes 2008, Bordeaux 2009
- P. Guitton : Jury IR CNRS; Bordeaux; 2007

3.11 Annexe C: Collaborations

3.11.1 Conventions or international cooperations

- accord Université Bordeaux 1-Université Nationale Autonome de Mexico ; prof. Garcia Ugalde; 2006 -2011
- Equipe associée INRIA Light ; University of British Columbia (Canada); 2004-2007
- Equipe associée INRIA Bird ; Zhejiang University ( Chine ); 2008-2011

3.11.2 Joint publications

- Gérard Assayag, IRCAM, équipe représentation musicale;
- Laurent Daudet, LAM, Institut Jean Le Rond D’Alembert, Paris
- Olivier Derrien, Laboratoire de Mécanique et d’Acoustique, CNRS, Marseille
- Laurent Girin, GIPSA-lab, INPG, Grenoble
- LTCI, Télécom ParisTech, Paris; Gaël Richard, Roland Badeau et Bertrand David
- X. Ganier, P. Reuter, T Boubekr Ausonius; Université Bordeaux 3
APPENDIX – IS

Pascal Desbarats, Laboratoire d’Anthropologie des Populations du Passé, Université Bordeaux 1
P. Reuter, T Boubekeur, LIPSI; ESTIA
Philippe Depalle : CIRMMT / SPCL; McGill University , Montréal, Québec, Canada ; since 2002
Julius O. Smith III : CCRMA; Stanford University; Californie; USA ; since 1998
Jenny Benoist-Pineau : Université de Växjö, Suède; Conseil scientifique de l’ICMM (International Center of Mathematical Modelling);
X. Ganier et C. Schlick Université de Montréal; Canada : Thèse co-encadrée
P. Guitton : Zhejiang University; Chine : Thèse co-encadrée 2009-2011
P. Guitton, X. Ganier, P. Reuter : Beijing Normal University; Chine : Projet de recherche sur la reconstruction 3D
M. Hachet Bauhaus - Universitat Weimar; Allemagne : co-rédaction d’article

3.11.3 Others
- Gérard Assayag; IRCAM (Paris)
- Laurent Daudet; Institut Jean Le Rond D’Alembert (Paris)
- Olivier Derrien; Laboratoire de Mécanique et d’Acoustique (Marseille)
- Laurent Girin; GIPSA-lab (Grenoble)
- Gaël Richard, Roland Badeau et Bertrand David; LTCI (Paris)
- Robert Vergnioux; Ausonius (Université Bordeaux 3)
- Philippe Depalle; CIRMMT / SPCL, McGill University (Canada)
- Julius O. Smith; III : CCRMA, Stanford University (Etats-Unis)

3.11.4 Guests
- Philippe Depalle; McGill University( Canada); 2005(3 months)
- Alberto Del Bimbo; Université de Florence (Italie); 2008 (3 days)
- B. Froëlich; Bauhaus Universität ( Allemagne); 2007 (1 week)
- Francisco Garcia-Ugalde; Université Nationale Autonome de Mexico (Mexique); 2006 (1 month)
- Ofer Hadar; Université Ben Gurion ( Israel); 2006 (3 days),2007 (3 days)
- John Hamer; The University of Auckland ( New Zealand); 2009 (1 month)
- Y. Kitamura; University of Osaka (Japon); 2005 (1 week)
- Hans Meine; Universitäti Hamburg ( Allemagne) 2008 (1 week)
- Q. Peng; Zhejiang University (Chine); 2006 (1 week ;)
- P. Poulin; Université de Montréal ( Canada); 2005 (1 week), 2009 (1 week)
- Tamas Szyranyi; PPKU (Hongrie); 2008(3 days)
- M. Van de Panne; University of British Columbia,( Canada); 2005 (1 week)
- H. Zhang; Zhejiang University ( Chine); 2007 (3 weeks), 2009 (1 month)

3.11.5 Invitations
- Jenny Benoist-Pineau : Université Växjö;Växjö (Suède); 2006 ( 1 week), 2007 (1 week), 2009 (3 days)
- “ : Université de Caroline du Nord at Chapel Hill (Etats-Unis); 2009 (3 days)
- Lionel Carminati : Université Queen Mary (Royaume-Uni); 2005 ( 1 week)
- Jean-Sébastien Franco : Zhejiang University (Chine); 2008 (1 week)
- “ : Zhejiang University (Chine); 2007 (2 weeks), 2008 (2 weeks)
- P. Guitton : Zhejiang University (Chine); 2007 (1 week)
- “ : Beijing Normal University (Chine); 2008 (1 week)
- “ : North West University (Chine); 2008 (2 weeks)
- “ : Zhejiang University (Chine); 2008 (1 week)
3.12 Annexe D: Contracts and valorisation

3.12.1 Institutional contracts

- Semantic Multi-Modal Analysis of Digital Media; COST292; 2005-2009
- XmediaIFP6; 2006-2009
- ARGOS; TECHNOVISION; 2005-2007
- Animare; ANR; 2009-2012
- Dalia; ARA Masse de données; 2006-2009
- Geodib; ANR Blanche; 2006-2010
- Fogrimi; ANR Masse de données; 2006-2010
- ICOS-HD; ANR MDCA; 2006-2010
- Mitoscop; ACI Biosys; 2003-2006
- Monitoriong Vidéo Embarqué; PEPS CNRS; 2007-2008
- NatSim; ACI Masse de données; 2006-2008
- Partge; RNTL; 2006-2009
- RaxEnv; RNTL; 2006-2009
- Show; ACI Masse de données; 2003-2005
- Tomatoflux; ANR Blanche; 2006-2009
- Cap Digital; ANR Virage; 2008-2010
- SOUL; Pôle de compétitivité AESE; 2006-2009
- Mitoscop; ANR Franco/Britannique sysBio; 2007-2010
- Projet STIC-Asie Réalité virtuelle; France-Chine-Corée-Japon-Singapour-Taiwan; 2004-2006
- Programme ICT France-Japon; Projet JST-CNRS; 2008-2010
- Mitoscop; ANR Franco/Britannique sysBio; 2007-2010
- Projet STIC- Asie Réalité virtuelle; France, Chine, Corée, Japon, Singapour, Taiwan; 2004-2006
- Programme ICT France-Japon; Projet JST-CNRS; 2008-2010
- Réseau européen sur l’étude de la GRF (fonction de filtrage du rein); France/Royaume Uni/Danemark; since septembre 2003
- UNAM (Université Nationale Autonome de Mexico); prof. Garcia Ugalde; accord UBx1-UNAM; 2006-2011
- University of British Columbia, Vancouver; Canada; Équipe associée INRIA Light; laboratoire Imager; 2004-2007
- University of London; Christophe Rhodes; Goldsmiths; since 2006 Xmedia; PCR 6; since 2006;
Zhejiang University, Hangzhou; Chine; Equipe associée INRIA Bird; laboratoire CAD & CG; 2008 - 2011

3.12.2 Industrial contracts
- Adacis; Contrat Cifre; 2009-2012
- Aérodrones; Encadrement CIFRE; 2008-2010
- Be tomorrow; Outil méthodologique pour le calcul des coordonnées d’un joueur sur le terrain; 2005-2006
- FT R&D; Rendu non photo-réaliste d’environnements urbains; 2004-2005 et 2006-2007
- FT R&D; Encadrement CIFRE; 2006-2008
- Immersion; Diffusion du CAT; 2005
- MaxSea; Encadrement CIFRE; 2009-2011
- Mirane Contrat; Cifre; 2008-2011
- MIRO; ARC INRIA; 2005-2006
- Medimaps; Etude faisabilité et de qualité d’image; mars 2006
- Terabook; avec le CPMOH et la société I2S; janvier 2006- aout 2008
- SC2X; Doctorant conseil; 2008-2009
- Société BlueYeti; ANR Virage; 2008-2010
- Société Jazzmutant; ANR Virage; 2008-2010
- Société Puce Muse; ANR 2PIM; 2007-2009
- Vitec; CIFRE; 2004-2007

3.12.3 Patents
- Société iKlax Media; Bidart; co-publication, dépôt de brevet commun; Procédé de gestion de flux audionumériques, déposé en 2008, membres du laboratoire : S. Marchand, M. De Sainte-Catherine
- GIPSA-lab Grenoble, dépôt de brevet commun; Procédé de numérisation de livres en 3 dimensions par ondes terahertz, d’posé en 2008, membres du laboratoire : C. Aguerre, P. Desbarats
- I2S, CPMOH, LaBRI : dépôt de brevet commun; Procédé de séparation de sources utilisant une information de tatouage, déposé en 2009, membres du laboratoire : S. Marchand

3.13 Annexe E: Thesis and HDR of the team

3.13.1 Habilitations
- Jean-Philippe Domenger; « Structuration d’images, visualisation d’informations et vidéo »; date 2006
- Xavier Granier; Representations toward more User-friendly 3D Synthesis; 2009
- Jacques Olivier Lachaud; « Espaces non-euclidiens et analyse d’image : modèles déformables riemanniens et discrets, topologie et géométrie discrète »; 6 décembre 2006
- Sylvain Marchand; "Avancées en modélisation spectrale du son musical"; 5 décembre 2008;

3.13.2 Thesis
- Sylvie Alayrangues; (directeur : Achille Braquelaire); « Modèles et invariants topologiques en imagerie numérique »; 8 juillet 2005
- Jean-Baptiste De La Rivière; (directeur : Pascal Guittion); « Suivi vidéo de mouvements pour l’interaction »; 20 juin 2005
- Baudouin Denis de Senneville; (directeur : Christophe Schlick et Pascal Desbarats); « Correction des mouvements pour la thermométrie temps réel guidée par IRM »; 9 décembre 2005
Ludovic Garreau; (directeurs : Pascal Guitton et Nadine Couture, ESTIA); « Elaboration d’une interface tangible pour l’assemblage en CAO »; 12 septembre 2005

Jan Nesvadba; (directeur : Jenny Benois-Pineau); « Segmentation sémantique des Contenus Audio-Visuels »; 5 novembre 2005

Francesca Manerba; (directeurs : Riccardo Leonardi, Université de Brecia et J. Benois-Pineau); « Object identification in image sequences for content indexing »; 30 novembre 2005

Sabine Pérès; (directrice : Marie Beurton-Aimar); « Analyse structurelle des réseaux métaboliques et application au métabolisme énergétique mitochondrial »; décembre 2005

Cédric Aguerre; (directeur : Achille Braquelaire); « Méthodes et outils pour l’analyse de l’activation cérébrale en IRMf »; 21 décembre 2006

Lionel Carminati; (directeur : Jenny Benois-Pineau); « Détection et suivi d’objets dans les scènes animées : Application à la vidéo surveillance »; 27 juin 2006

Florian Levet; (directeurs : Christophe Schlick et Xavier Granier); « Modélisation et édition d’objets 3D : du prototype au modèle final. »; 11 décembre 2006

Nicolas Louis; (directeurs : Jenny Benois-Pineau et Myriam Desainte Catherine); « Indexation Cross-modale vidéo/son des contenus multimédias »; 6 juin 2006

Matthias Robine; (directeur : Robert Strandh); "Analyse de la performance musicale et synthèse sonore rapide"; 13 décembre 2006

Tamy Boubekeur; (directeur : Christophe Schlick); « Hierarchical processing, editing and rendering of acquired geometry. »; 21 septembre 2007

Luis Kabongo; (directeur : Christophe Schlick et Pascal Desbarats); « Simulation et optimisation de trajectoires pour les ultrasons focalisés en thermothérapie »; 07 décembre 2007

Petra Kraemer; (directeurs : Jenny Benois-Pineau, Jean-Philippe Domenger); « Construction des mosaïques de super-résolution à partir de la vidéo de basse résolution. Application au résumé vidéo et la dissimulation des erreurs de transmission »; 15 octobre 2007

Joëlyn FRECHOT; (directeurs : Bertrand Le Saec et Jean-Christophe Gonzato); « Simulation réaliste de surfaces océaniques. »; 29 juin 2007

Charles Lalès; (directeurs : Robert Strandh et Marie Beurton-Aimar); « Modélisation gros grain et simulation par SMA. Application à la membrane interne mitochondriale »; 13 décembre 2007

Nicolas Parisey; (directeur : Marie Beurton-Aimar); « Modélisation d’objets biologiques pour la simulation de processus métaboliques : système multi-agents et métabolisme énergétique mitochondriale »; Novembre 2007

Guilhem Peretié; (directeurs : Achille Braquelaire et Jean-Philippe Domenger); « Segmentation spatio-temporelle temps-réel de flux vidéo pour un encodage dépendant de son contenu »; 16 mars 2007

Joachim Poudourex; (directeurs : Pascal Guitton et Jean-Christophe Gonzato); « Création semi-automatique de modèles numériques de terrains. Visualisation interactive sur terminaux mobiles communicants » 29 juin 2007

Martin Raspaud; (directeurs : Myriam Desainte-Catherine et Sylvain Marchand); "Modèle spectral hiérarchique pour les sons et applications"; 24 mai 2007

François de Vieilléville; (directeur : Braquelaire Achille); « Analyse des parties linéaires des objets discrets et estimation de caractéristiques géométriques »; juin 2007

Gregory Maclair; (directeurs : Jenny Benois-Pineau, Pascal Desbarats); « Développement d’algorithmes temps réel de traitement de séquences d’images animées biomédicales pour la thermothérapie guide par IRM »; 5 décembre 2008

Antoine Allombert; (directeur : Myriam Desainte-Catherine); "Aspects temporels d’un système de partitions interactives" soutenance prévue fin juin 2009

Jérôme Baril; (directeur : Christophe Schlick); « Méthodes multi-échelles pour le codage adaptatif de modèles 3D représentés par des images de points »; 2009

Julien Hadim; (directeurs : Christophe Schlick et Xavier Granier); « Étude en vue de la multirésolution de l’apparence.»; lundi 11 Mai 2009
– Joan Mouba; (directeur : Myriam Desainte Catherine et Sylvain Marchand); «Manipulations spatiales de sons spectaux»
– Romain Pacanowski; (directeurs : Christophe Schlick et Xavier Granier); « Modes de représentation pour l'éclairage en synthèse d’images »; 2009
– Jérôme Baril; (directeur : Christophe Schlick); « Modèles de représentation multi-résolution pour le rendu photo-réaliste de matériaux complexes. »; 2009
– Joan Mouba; (directeur : Myriam Desainte Catherine et Sylvain Marchand); juin 2009

3.13.3 Jointly advised thesis
– Thèse en co-tutelle; Université de Brescia (Italie); 2002-2005
– Thèse en co-tutelle; Université PPKU de Budapest (Hongrie); 2006-2010
– Thèse en co-tutelle; Université de Sfax (Tunisie); 2005-2010
– Thèse co-encadrée; Université de Montréal (Canada); 2006-2009
– Thèse en co-tutelle avec l’université de Tsin-Hua; Taiwan; 2006-2009

3.14 Annexe F: Scientific responsabilities

3.14.1 National
– Jenny Benois-Pineau : GDR ISIS; Coordinatrice de l’action IRIM du GDR ISIS; 2007-2009
– P. Guitton : Chargé de mission Formation par la recherche de l’INRIA; since 2006
– C. Schlick : Comité scientifique du GDR Algorithmique, Langages et Programmation; since 2006

3.14.2 Scientific committee
– Conseil scientifique ACI GRID; 2001-2006 (P. Guitton)
– Comité scientifique du projet Visitor, Action Marie Curie; Grenoble; 2008 (P. Guitton)

3.14.3 Other
– Myriam Desainte-Catherine : Coprésidence de l’AFIM (Association Française d’Informatique Musicale); 2002-2009
– J.C. Gonzato : Conseil d’administration de l’AFIG; since 2007
– P. Guitton : Conseil d’administration de l’AFRV; since 2005
– P. Guitton : Directeur adjoint LaBRI; 2005-2006
– P. Guitton : Site de diffusion scientifique, Interstices, since 2007
– Achille Braquelaire : Vice-président CEVU; since 2008
– Directrice adjointe LABRI; Myriam Desainte Catherine; since 2008
– Jean Philippe Domenger : Directeur adjoint LaBRI; since 2007
– Robert Strandh : Directeur du département Informatique de l’UFR; since 2006
– Henri Nicolas : Co-directeur du master Miage; since 2006
– Marie Beurton-Aimar : Atelier épigénomique-génopole Evry-groupe SMAbio, since 2006
Activities:

- Theme *QoS and security in new generation networks*  
  *(COMET : COntext-aware ManagEment & neTworking)*  
  Head: F. Krief  
  Keywords: New architectures of communication, convergence of networks and services, end-to-end service level negotiation, quality of service and security of communications, adaptive transport of multimedia flow, autonomic networking

- Theme *Modelling and testing of systems*  
  Head: R. CASTANET  
  Keywords: Formal modelisation, conformity/interoperability/robustness tests, automatic test generation, communicating systems and protocols, critical systems with temporal constraints, embedded systems, security systems, Web services

- Theme *Distributed systems and objects*  
  Head: S. CHAUMETTE  
  Keywords: Mobile communicating systems, nomadic systems, wireless, delay and disruptive tolerant networks, dynamicity, security, smart cards, embedded and distributed middleware, heterogeneity, adaptation, algorithms for mobile systems, models, validation

- Team-Project *Phoenix*  
  Head: C. CONSEL  
  Keywords: Design and implementing of programming languages, program analysis and transformation, operating systems, networking, pervasive computing
CHAPTER 4. TEAM LSR

4.1 Members
(at 31st of August 2009)

T1: Theme QoS and security in new generation networks
    (COMET : COntext-aware ManagEment & neTworking)
T2: Theme Modelling and testing of systems
T3: Theme Distributed systems and objects
E4: Team-Project Phoenix

4.1.1 Permanent faculty

<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
<th>Themes</th>
<th>Administrative charges</th>
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<tr>
<td>Castanet, R.</td>
<td>PR ENSEIRB</td>
<td>×</td>
<td>Dir. ENSEIRB 2005-2008</td>
</tr>
<tr>
<td>Chaumette, S.</td>
<td>PR U. Bordeaux 1</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Conseil, C.</td>
<td>PR ENSEIRB</td>
<td>×</td>
<td>Dir. dépt. Télécom.</td>
</tr>
<tr>
<td>Krief, F.</td>
<td>PR ENSEIRB</td>
<td>×</td>
<td></td>
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<tr>
<td>Magoni, D.</td>
<td>PR U. Bordeaux 1</td>
<td>×</td>
<td></td>
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<tr>
<td>Ahmed, T.</td>
<td>MCF ENSEIRB</td>
<td>×</td>
<td>Resp. relations internationales dépt. Télécom.</td>
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<tr>
<td>Bromberg, D.</td>
<td>MCF U. Bordeaux 1</td>
<td>× ×</td>
<td></td>
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<tr>
<td>Delord, X.</td>
<td>MCF ENSEIRB</td>
<td>× × ×</td>
<td>Co-dir. dépt. RSI</td>
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<tr>
<td>Félix, P.</td>
<td>MCF IUT Bordeaux 1</td>
<td>×</td>
<td></td>
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<tr>
<td>Negru, D.</td>
<td>MCF ENSEIRB</td>
<td>×</td>
<td></td>
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<tr>
<td>Réveillére, L.</td>
<td>MCF ENSEIRB</td>
<td>× ×</td>
<td></td>
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<tr>
<td>Rollet, A.</td>
<td>MCF ENSEIRB</td>
<td>×</td>
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<tr>
<td>Rubi, F.</td>
<td>MCF U. Bordeaux 1</td>
<td>×</td>
<td>Chargé de mission TIC U. Bordeaux 1</td>
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</tbody>
</table>

Total ETPC: 6.5 (PR: 5 MCF: 8)

1. Restricted to (vice-)presidents and (deputy-)directors of school, laboratory, department, and of international relationships.
2. Equivalent Temps Plein Chercheur.
### 4.1.2 Temporary personnel

<table>
<thead>
<tr>
<th>Name</th>
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<th>Name</th>
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<tr>
<td>Albert, J.</td>
<td>Doct 2007-</td>
<td>Laplace, R.</td>
<td>Doct 2008-</td>
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<td>Benmammar, B.</td>
<td>Doct -2006</td>
<td>Mbaye, M.</td>
<td>Doct 2006-</td>
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<td>Berrada, I.</td>
<td>Doct -2005</td>
<td>Mercadal, J.</td>
<td>Doct 2006-</td>
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<td>Cao, T-D.</td>
<td>Doct 2008-</td>
<td>Palix, N.</td>
<td>Doct -2008</td>
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<tr>
<td>Casteigts, A.</td>
<td>Doct -2007</td>
<td>Saad Korchef, F.</td>
<td>Doct -2006</td>
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<td>Chauveau, E.</td>
<td>Doct -2006</td>
<td>Tabary, R.</td>
<td>Doct 2008-</td>
</tr>
<tr>
<td>Ferchaud, F.</td>
<td>Doct -2006</td>
<td>Mbarek, N.</td>
<td>ATER -2007</td>
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<td>Jemili, I.</td>
<td>Doct 2005-</td>
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Total\(^1\) ETPC: **14.3**

### 4.1.3 Personnel under industrial contract

<table>
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</thead>
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<tr>
<td>Abdallah, A.</td>
<td>Doct 2007-</td>
<td>Drey, Z.</td>
<td>Doct 2006-</td>
</tr>
<tr>
<td>Ben Mbarka, M.</td>
<td>Doct 2007-</td>
<td>Lu, J.</td>
<td>Doct 2008-</td>
</tr>
<tr>
<td>Bruneau, J.</td>
<td>Doct 2008-</td>
<td>Mackaya, M.</td>
<td>Doct -2005</td>
</tr>
<tr>
<td>Diouf, M.</td>
<td>Doct -2007</td>
<td></td>
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</tbody>
</table>

Total\(^1\) ETPC: **4.7**

---

1. *Prorata temporis.*
4.2 Research summary

The work of the LSR research group relates to various problems regarding networks. This group was created during the last evaluation of the laboratory in order to coherently combine related and complementary research topics. The creation of the Comet topic, the strong evolution of older topics such as SOD, and the creation of Phoenix, which is a joint project with INRIA Bordeaux Sud-Ouest, were additional reasons for setting up the LSR group.

The group has four main research directions or topics (which will be described in details in the following):

**Comet**  The research activities of the COMET theme cover the control and management of QoS and security in next generation networks. These networks are becoming multiservice, converged and supporting fixed, mobile and wireless users through heterogeneous infrastructure and access technologies. COMET activities can be divided into three main research areas: (1) negotiation and automatic deployment of secure services with constraints on quality of service in 4th generation mobile networks, (2) autonomy in operator networks and ad hoc sensor networks, (3) control and adaptation of multimedia QoS to available network QoS.

In this context, new mechanisms, algorithms, models, protocols and communication architectures have been proposed.

**SOD**  The aim of the Distributed Systems and Objects group is to make it possible, simple and as far as possible efficient, to use and manage the computing or functional pieces of equipment that are connected to a wired or a wireless network. This requires the provision of tools, environments and validated middleware (offering a high level of abstraction while allowing a relatively fine grain control of the underlying layers) as well as actual applications. This research activity was initially focused on connected coarse grain distributed systems (clusters, grids, etc.) and was based on distributed object technologies (therefore the name SOD). The target of the work has evolved in a natural way to mobile communicating systems, which are also distributed by nature, but which bring unique challenges. The activities of the SOD group rely on the following skills that have been developed by its member researchers: object technologies and associated models, middleware, virtual machines; security in a distributed framework (PKIs, smart cards, etc.); mobility related technologies and associated models.

**Phoenix**  The Phoenix group develops a software engineering approach aimed to produce programs whose reliability can be guaranteed with respect to domain-critical properties. This approach revolves around the design of domain-specific languages. These high-level languages provides syntax and semantics to guide the programmer and to ensure reliability and performance. Our research has been validated in a number of domains, including operating systems, stream processing and telephony. Our latest research efforts concentrate on the pervasive computing domain.

**MTSC**  This research covers aspects of modeling, Verification and testing of computer systems, more precisely communication protocols, embedded systems, systems based on components and extensions to security systems. The activity of this theme focuses on the problem of testing (conformance, interoperability and robustness) and the automatic generation of test sequences. This requires new models because of growing complexity of systems and services. The arrival of real-time services with QoS and high speed networks implies the need to take into account real time constraints in all phases of the engineering cycle.

Recent work on this theme mainly take into account timed systems with variables, formalization for robustness test, the development of new methods for testing of critical systems, testing new items, such as web services. A platform for testing timed systems was developed.
4.2.1 Comet

**Keywords**: New architectures of communication, end-to-end service level negotiation, adaptive transport of multimedia flow, autonomic networking

**Overview**
The research activities of the COMET theme cover the control and management of QoS and security in next generation networks. These networks are becoming multiservice, converged and supporting fixed, mobile and wireless users through heterogeneous infrastructure and access technologies. Three major research themes were identified:

**Focus 1**: Negotiation and automatic deployment of secure services with constraints on quality of service in 4th generation mobile networks

Our work focused on the negotiation of service levels in heterogeneous environments, control of QoS in mobile environments as well as specifying a user interface for 4G terminals.

Main results:
- Specifying architecture and associated protocols for negotiation, monitoring and dynamic configuration of services in new generation IP networks;
- Modeling the prediction of user mobility;
- Specifying a signaling framework for advance resources reservation while minimizing service degradation during the handover;

**Focus 2**: autonomic networking

Our research in this area focuses on self-organization and self-optimizing of operators’ networks as well as wireless sensor networks in order to satisfy the application needs while optimizing the energy consumption.

Main results:
- Specifying a knowledge plane based on distributed and collaborative learning;
- Service level negotiation protocol using the Web services technology in a self-management framework;
- Proposal of a Geographic Energy-Aware Multipath Stream-based Routing Protocol for WM-SNs

**Focus 3**: Control and adaptation of multimedia QoS to available network QoS

The objective is to implement video services capable of adapting themselves automatically to the available and dynamically changing network QoS while taking into account the characteristics of the used terminal, the user profile and QoS mechanisms offered in the underlying networks to assure a QoS guarantee to end-users.

Main results:
- Proposal of mechanisms for enhancing and adapting the application level QoS of video services transmitted over wireless 802.11.
- Proposal of a QoS adaptation mechanism for large-scale video streams delivering over P2P networks;
- Proposal of a mechanism for optimizing of network-aware overlay application to enhance video content distribution.
4.2.2 SOD

**Keywords:** Mobile communicating systems, nomadic, wireless/delay and disruptive tolerant networks, dynamicity, security, smart cards, embedded and distributed middleware, heterogeneity, adaptivity, algorithms, models, validation.

**Presentation**

The activities of the SOD group have initially focused on coarse grain distributed systems and have then moved towards the world of mobile communicating pieces of equipment/objects. The goal of these activities is to facilitate the use of mobile communicating devices by offering virtual machines, administration tools, development tools, and effective secured and formally validated applications, that meet users, programmers and administrators expectations. The applications must therefore be specifically designed to operate in a mobile environment and the associated middleware should offer them adequate mechanisms. **The problems of mobility, ubiquity, heterogeneity and safety are major scientific issues**, and barriers to the effective use of the new opportunities offered by mobile systems.

**Summary of main results**

- **Distributed computing:**
  In this area, we have designed and implemented formally validated software tools [Cs20]. We also contributed to show the relevance of the distributed objects based approach for scientific computing in the ANR project called DISCOGRID (DIStributed objects and COmponents for high performance scientific computing on the GRID'5000 test-bed) with INRIA Sophia, IRISA, IMAG and EADS.

- **Algorithms, applications and tools for fleets of mobile communicating devices:**
  The fact that pieces of equipment may appear or disappear from the network at any moment raises the problem of the dynamicity of the underlying graph. While so far most results assume static graphs, we extended [Cs14] the existing approaches based on graph re-labelings so as to take into account the dynamic environments in which we are interested ([Cs3] and Milcom 2006 [Cs4] and 2007 [Cs5], DGA PhD and ANR project Sarah). In this context, we have achieved significant results in terms of modeling and characterization (2009 Sirocco [Cs15]) of algorithms and mobile applications. In addition, we deployed a platform based on communicating mobile devices (phones, PDAs and PCs) equipped with Wi-Fi or Bluetooth. This was supported by the laboratory, by private companies, by Région Aquitaine and Bordeaux 1 University.

- **Securing mobile systems:**
  This work builds on the experience of the SOD group in the field of smart cards and on a close relationship with the Formal Methods group (Olivier Ly) [Ca25], which takes place in the framework of the Cryscoe ANR project and of a co-supervised PhD thesis. We have made significant progress on trust management in dynamic (unscheduled) mobile networks [Ca7]. We have also deployed a platform based on Java Cards[Cs3] (award for the best innovative technology at e-Smart 2005 conference [?]); even if one cannot expect any efficiency from this platform, it can be used to validate the functional and security related aspects that are required in a sensitive context [Rs5, Ca32]. This platform can also simulate mobile devices by tearing and re-insertion of cards.

  Based on these results we develop an approach in which each mobile device is equipped with a smart card [Ca7, Ca94]. The cards provide security services that are used in the higher level layers by the mobile devices. This work partly took place in the SARAH (Asynchronous Services for Ad Networks Hoc) ANR project.
4.2.3 Phoenix

**Keywords**: Programming language design and implementation, program analysis and transformation, operating systems, networking, telecommunications, pervasive computing.

**Context**

The frantic nature of technological advances in the area of multimedia communications, compounded with the effective convergence between telecommunication and computer networks, is opening up a host of new functionalities, placing service creation as a fundamental vehicle to bring these changes to end-users.

This situation has three main consequences: (1) service creation is increasingly becoming a **software intensive area**; (2) because communication services are often heavily relied on, intensive service creation must preserve **robustness**; (3) the growing multimedia nature of communication services imposes **high-performance requirements** on services and underlying layers.

The Phoenix research group develops principles, techniques and tools for the development of communication services. To address the requirements of this domain, the scope of our research comprises the key elements underlying communication services: the infrastructure that enables communication to be set up (e.g., signalling platform, transport protocols, and session description); the software architecture underlying services (e.g., the client-server model, programming interfaces, and the notion of service logic); and, communication terminals (e.g., terminal features and embedded systems).

**Main results**

Our approach covers two key aspects of the area of communication services: (i) definition of new Domain-Specific Languages (DSLs), using programming language technology to enable the specification of robust services; (ii) study of the layers underlying communication services to improve flexibility and performance. This research has been validated in the context of concrete application areas.

**DSLs for communication services.** Domain-specific languages (DSLs) are being successfully designed, implemented and used, both academically and industrially, in a variety of areas including interactive voice menus, Web services, and financial products, demonstrating that openness can be reconciled with robustness, without sacrificing performance [Ca51].

Our research is aimed to enable experts to design and implement DSLs [Cs21, Cs47]. To put this work into practice, we mainly targeted the following application areas: networking [Cs12], telecommunication [Ca74, Ca103, Cs11] and ubiquitous computing [Ca88, Ca47]. Part of our work on the creation of telecommunication services led to a patent [Au12] and a technology transfer to Siderion technologies, a spin-off of our research group.

**Supporting infrastructures.** We concentrate on improving the performance of servers and systems components, on both the server and client sides. Also, this part of our research includes work towards extending the scope of our research to ubiquitous computing.

Among our key results is the automatic specialization of protocol stacks in OS kernels. In this work, we propose a strategy to automate this process using Program Specialization. Specialized code is loaded in generated dynamically and loaded in the kernel to be used by the application [Rs3].

Another achievement of the group is the design and implementation of an integrated environment dedicated to pervasive computing applications. This environment, named DiaStar, is aimed to cover their entire life-cycle, including their specification [Ca62], development [Ca24], simulation [Cs10], and deployment [Ca63, Ca18].
4.2.4 MTSC

**Keywords:** Formal modeling, conformance testing, robustness testing, interoperability testing, timed and critical systems, automatic test generation, web services, systems based on components, communication protocols.

**Introduction**

This research covers aspects of modeling, verification and testing of computer systems, more precisely communication protocols, embedded systems, systems based on components and extensions to security systems. The activity of this theme focuses on the problem of testing (conformance, interoperability and robustness) and the automatic generation of test sequences. This requires new models because of growing complexity of systems and services. The arrival of real-time services with QoS and high speed networks implies the need to take into account real time constraints in all phases of the engineering cycle. The team also looks to new services: Web services. They have original characteristics requiring new testing methods. A project ANR (Webmov) is currently underway on this area.

**Summary of main results**

- **combinatorial explosion of test generation:** The automatic test generation from a specification faces a problem of combinatorial explosion, especially in the case of timed systems. To address this problem, we use a technique of test by objectives and/or symbolic test technique, based on a type of a synchronized product between the objective test and the formal specification. A definition of timed extended finite state automata is proposed. The consideration of temporal aspects has been extended in the project Averroes, labeled by the RNTL. The competence of the team in the field of testing timed systems also have us allowed to participate in the project ANR TESTEC. This project compares the automation and computer science approaches to find new solutions for testing critical systems. Recently, the team has focused on Web services for adapting the same approaches (project ANR Webmov).
- **robustness testing:** The industrial world takes a live interest in robustness testing. A major theoretical difficulty is to define what falls under conformance and what is the robustness. We propose to broaden the definition of the IEEE robustness to "the ability of a system or a component to operate in an acceptable manner in the presence of faults or environmental stress. This expanded definition takes into account the possibility of degradation of service, eg switching to a damaged or degraded state of the environment. The thesis of Fares Saad Korcheff focused on robustness testing.
- **conformance Testing:** For the conformance testing, the activity of the team in RNRT CALIFE project and the Averroes project helped contribute to the development of a platform for modeling, verification, proof and test generation. Communication protocols with timed constraints were used as examples. This platform is based on a software bus that interconnects modeling, verification, proof and test generation tools. The interfaces are XML type.
- **interoperability testing:** For interoperability testing, the Calife platform has been extended and resulted in a specific platform enabling interoperability testing, TGSE, with the work of two graduate students (PhD): I. Berrada and P. Chamuczynski, the last one in collaboration with the University of Goettingen in Germany.
CHAPTER 4. TEAM LSR

4.3 Highlights

- Creation of the Siderion Technologies start-up by the Phoenix group. Papers in the press (Les Echos, 01 Informatique, Journal of Telecoms, BFM Radio, etc.). Received the Innovaday technology transfer award given by the Président of the Conseil Régional d’Aquitaine.
- Creation of a smart space containing a varied set of communicating devices (multimedia, sensors, actuators). This platform is designed to test scenarios of ubiquitous computing developed by using approaches and software engineering tools designed in the Phoenix research group.
- Phoenix was awarded the "Best Student Paper Award" during IPTComm 2008. A SIP-based Programming Framework for Advanced Telephony Applications by Wilfried Jouve, Nicolas Palix, Charles Consel & Patrice Kadionik received the Best Student Paper Award at the last IPTComm (http://iptcomm.org/) held in Heidelberg (Germany) in July 2008. This paper presents a quick and robust programming solution for heterogeneous and dynamic environments, which are key features of advanced telephony systems.
- Creation by COMET of dissemination platforms for audio-visual services for wireless and mobile terminals.
- Specification and implementation (COMET) of a end to end negotiation protocol at service level in an autonomous management environment.
- Submission of a proposal by SOD (O. Ly) at NIST for the hash function SHA-3, accepted for the first round.
- Set up (SOD) of the European Project ITEA2 Smart Urban Spaces (Gemalto, Thales, etc.).
- SOD awarded the prize for the Best Innovative Technology at the International Conference E-smart 2005 for its Smart Card Grid.
- Set up of a technical platform (SOD and COMET) in a room provided by the laboratory. This space allows to deploy expensive and/or fragile pieces of hardware to conduct significant experiments (sensors, mobile phones, smart cards, etc.).
- SOD has defined and is implementing a platform of 100 mobile communicating systems (mobile phone + smart card + GPS) for securely collecting mobility traces. This is achieved with the collaboration of the members of the laboratory and of the students of the Systems and Networks track of the Computer Science Master, University Bordeaux 1.

Competitive examination Awards

4.4 Visibility

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CHAPTER 4. TEAM LSR

4.5 Jurys

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4.6 Collaborations, contracts and valorization

For world map, see Figure 1.2.

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4.7 Thesis and HDR

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4.8 Publications of the team LSR

4.8.1 Summary

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<td>Other publications</td>
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Be reminded that all the publications listed here under the category Journals and the vast majority of those listed under the category Conferences and Books (and many of those listed under the category Other) are publications of Rank A as defined by the AERES. Indeed, it is the team that has chosen the journals and the conferences that are highlighted with the label Selection in order to put emphasis on certain publication media, and in no case does this imply the declaration of the complement of this selection as being of lower quality.

4.8.2 Journals [ACL]

(journals with editorial board registered by AERES or by international data bases)

Selection


BIBLIOGRAPHY – LSR


Other


4.8.3 Conferences [INV, ACTI, ACTN]

(invited conferences, international or national conferences with proceedings)

Selection


Invited
(invited speaker in international or national conferences)


Other


[CA29] M. A. Chalouf and F. Krief, La négociation de niveau de service dans un environnement ubiquitaire, in 9ème conférence internationale sur les NOuvelles TEchnologies de la REpartition (NOTERE 2009), 2009.


[Ca75] O. Ly, F. Krief, and M. Ben Mbarka, Entrusting remote software executed in an untrusted computation helper, in Network and Service Security (N2S'2009), 2009.


[Ca81] N. Mbarek and F. Krief, La négociation du niveau de service dans une architecture de gestion autonome, in 7ème Colloque francophone de Gestion de Reseaux et de Services, 2006, pp. 207–222.


[Au26] L. Dehni, Y. Bennani, and F. Krief, *Une approche neuronale adaptative de routage minimisant la consommation d’énergie dans les réseaux de capteurs*. 2005. [hal-00084643]


4.9 Annexe A: Visibility

4.9.1 Editorial board, invited editor

- Advanced Video Services Delivery over Heterogeneous Networks, IEEE Computer Society (T. Ahmed, co-éditeur 2008)
- International Journal On Advances in Internet Technology (S. Chaumette, membre du comité d’édition depuis 2009)
- International Journal On Advances in Networks and Services (S. Chaumette, membre du comité d’édition depuis 2009)
- International Journal of Network Protocols and Algorithms (S. Chaumette, membre du comité d’édition depuis 2009)
- Traité IC2, Réseaux et Télécoms, L’autonomie dans les réseaux, Hermes Science (F. Krief, éditrice 2006)

4.9.2 Steering committee

- ICIW, International Conference on Internet and Web Applications and Services, 2009 : Venise, Italie (S. Chaumette, depuis 2009)
- WISTP, 3rd Workshop in Information Security Theory and Practice, Bruxelles, Belgique (S. Chaumette, 2009)
- GPCE, Seventh International Conference on Generative Programming and Component Engineering, Nashville, Tennessee (C. Consel, 2008)
- IWJPDC, International Workshop on Java for Parallel and Distributed Computing, devenu International Workshop on Java and Components for Parallelism, Distribution and Concurrency en 2007 (S. Chaumette, co-créateur, depuis 1999)

4.9.3 Program committee

- WISTP 2008, 2nd Workshop in Information Security Theory and Practice, Seville, Espagne (S. Chaumette, co-président)
- MMN08, 11th IFIP/IEEE International Conference on Management of Multimedia and Mobile Networks and Services, Sanos, Grèce (A. Toufik président)
- CFIP 2005, Colloque francophone sur l’Ingénierie des Protocoles, Bordeaux (R. Castanet Président)
- GRES 2006, 7ème Colloque francophone de Gestion de Réseaux et de Services, Bordeaux, France (F. Krief)
- Wise08, 1st ACS/IEEE International Workshop on Wireless Internet Services, Doha, Qatar (D. Negru)
- DSPD 2006, the 1st international workshop on Domain-Specific Program Development co-located with ECCOP, Nantes, France (L. Reveillère co-président)
- DSPD 2008, 2nd international workshop on Domain-Specific Program Development in association with GPCE & OOPSLA, Nashville, Etats-Unis (L. Reveillère co-président)
- N2S 2009, IFIP Network and Service Security Conference, Paris, France (S. Chaumette)
- ICC 2009, IEEE International Conference on Communications, Dresden, Allemagne (S. Chaumette)
- SecTech 2009, International Conference on Security Technology Jeju Island, Jeju, Corée (S. Chaumette)
- MCO’08. Modelling, Computation and Optimization in Information Systems and Management Sciences, Metz, France and Luxembourg (S. Chaumette)
- ICAS 2008, International Conference on Autonomic and Autonomous Systems, Gosier, France (S. Chaumette)
- SH’08 et 09, International Symposium on Smart Home, 2008 : Hainan Island, Chine; 2009 : Toronto, Canada (S. Chaumette)
- FGNC’08, Second International Conference on Future Generation Communication and Networking Hainan Island, China, December, 2008 (S. Chaumette)
- IAS 2007 International Symposium on Information Assurance and Securit (S. Chaumette)
- GRES 2007,Colloque francophone de Gestion de Réseaux et de Services, Tunis, Tunisie (R. Castanet)
- OPODIS’07, International Conference On Principles Of Distributed Systems Bordeaux (R. Castanet)
- CFIP’06, 08 et 09, Colloque francophone sur l’Ingénierie des Protocoles, 2006 : Tozeur, Tunisie; 2008 : Les Arcs, France; 2009 : La Réunion, France (R. Castanet)
- CRIMES’09, Colloque francophone Convergence ces Réseaux et de l’Informatique, (R. Castanet)
- IPTComm’2009, Principles, Systems and Applications of IP Telecommunications, Georgia Tech, Atlanta, Georgia, USA, 2009 (C. Consel)
- JFDLPA’2005, Journée Francophone sur le Développement de Logiciels Par Aspects, Lille, France, 2005 (C. Consel)
- TOOLS EUROPE’2006 et 2007, Zurich, Switzerland (C. Consel)
- GaMMa’2006, Global integrated Model Management, Shangai, China, 2006 (C. Consel)
- IDM’2006, Ingénierie Dirigée par les Modèles, Lille, France, 2006 (C. Consel)
- PADL’2008, Practical Aspects of Declarative Languages, San Francisco, CA, USA, 2008 (C.
Consel)
- ICMT’2008 et 2009, International Conference on Model Transformation, Zurich, Switzerland (C. Consel)
- 6ème atelier sur les Objets, Composants et Modèles dans l’Ingénierie des Systèmes d’Information, Perros-Guirec, France, 2007 (X. Delord)
- CFIP 2005, Colloque Francophone sur l’Ingénierie des Protocoles, Bordeaux, France (X. Delord)
- CFSE’2005 Conférence Francophone en Systèmes d’Exploitation, Le Croisic, France (L. Réveillère)
- I2CS 2008. 8ème conférence IEEE International Conference on Innovative Internet Community Systems. (A. Rollet)
- ISCC’07, IEEE Symposium on Computers and Communications, Aveiro, Portugal (T. Ahmed)
- MACE’09, 4th IEEE International Workshop on Modelling Autonomic Communications Environnements, Venice, Italy, 2009 (F. Krief)
- ISMW’09, International Symposium on Multimedia over Wireless, Leipzig, Germany, 2009 (F. Krief)
- RIVF’09, IEEE International Conference on Computing and Communication Technologies, Da Nang City, Viet Nam, 2009 (F. Krief)
- GIIS’09, IEEE Global Information Infrastructure Symposium, Hammamet, Tunisia, 2009 (F. Krief)
- WTS’09, IEEE International Wireless Telecommunications Symposium, Prague, Czech Republic, 2009 (F. Krief)
- WMNC’09, Second Joint IFIP Wireless and Mobile Networking Conference, Gdansk, Poland, 2009 (F. Krief)
- ICT’09, 16th IEEE International Conference on Telecommunications, Marrakech, Morocco, 2009 (F. Krief)
- AQTR’08, IEEE-TTTC International Conference on Automation, Quality and Testing, Robotics, Cluj-Napoca, Romania, 2008 (F. Krief)
- SACC’08, 4th International Conference on Self-organization and Adaptation of Computing and Communications, Glasgow, UK, 2008 (F. Krief)
- DNAC’05, 06, 07, 08 et 09, Congrès de Nouvelles Architectures pour les Communications, Paris (F. Krief)
- WISE’08, The 1st ACS/IEEE International Workshop on Wireless & Internet Services, Doha,
Qatar, 2008 (F. Krief)
- PWC’08, the 13th IFIP International Conference on Personal Wireless Communications, Toulouse France, 2008 (F. Krief)
- ECUMN’07 et 08, European Conference on Universal Multiservice Networks, 2007 : Toulouse, France ; 2008 : Sintra, Portugal (F. Krief)
- MMNS’08 et 09, IFIP/IEEE International Conference on Management of Multimedia and Mobile Networks and Services, 2008 : Samos Island, Greece ; 2009 : Venice, Italy (F. Krief)
- Netcon’08, IFIP/IEEE Wireless Days 2008, Dubai, United Arab Emirates, 2008 (F. Krief)
- WiMOB’08, IEEE International Conference on Wireless and Mobile Computing, Networking and Communications, Avignon, France, 2008 (F. Krief)
- NTMS’07, 08 et 09, International Conference on New Technologies, Mobility and Security, 2007 : Beirut, Lebanon ; 2008 : Tangier, Morocco ; 2009 : Cairo, Egypt (F. Krief)
- GRES’05, 06 et 07, Colloque Gestion de Réseaux et de Services, 2005 : Luchon, France ; 2006 : Bordeaux, France ; 2007 : Hammamet, Tunisie (F. Krief)
- CODS’07, International Conference on Complex Open Distributed Systems, Chengdu, China, 2007 (F. Krief)
- ICLAN’06 et 07, International Conference On Late Advances in Networks, Paris, France (F. Krief)
- Smartnet’06, Paris, France, 2006 (F. Krief)
- JDIR’04 et 05, Journées doctorales en informatique et réseaux, 2004 : Lannion, France ; 2005 : Troyes, France (F. Krief)
- MAN’05, IFIP Metropolitan Area Networks. Architecture, protocols, control, and management, Ho Chi Minh city, Viet Nam, 2005 (F. Krief)
- CNSR 2009. Communications Networks and Services Research Conference (CNSR), Moncton, Canada (D. Magoni)
- IEEE GLOBECOM 2009. IEEE Global Communications Conference, Honolulu, Hawaii, Etats-Unis (D. Magoni)
- WCNC’08, IEEE Wireless Communications & Networking Conference, Las Vegas, USA, 2008 (D. Négru)
- ICC’08, IEEE International Conference on Communications, Beijing, China, 2008 (D. Négru)
- Euroitv’08, European Interactive TV Conference, Salzburg, Austria, 2008 (D. Négru)
- TEMU’08, International Conference on Telecommunications & Multimedia, Ierapetra, Crete, Greece, 2008 (D. Négru)
- IARIA ICNS’08, The Fourth International Conference on Networking and Services, Gosier, Guadeloupe, 2008 (D. Négru)
- IEEE GLOBECOM 2009, IEEE Global Communications Conference, Honolulu, Hawaii, USA, 2009 (D. Négru)
- AQTR’08, IEEE International Conference on Automation, Quality and Testing, Robotics, Cluj-Napoca, Romania, 2008 (D. Négru)

4.9.4 Conference organization
- OPODIS’06 (10th International Conference On Principles Of Distributed Systems), Bordeaux, France (A. Rollet, Organisateur local et Publicity Chair)
- CFIP 2005, Colloque Francophone sur l’Ingénierie des Protocoles, Bordeaux, France (R. Castanet)
GRES 2006, 7ème Colloque francophone de Gestion de Réseaux et de Services, Bordeaux, France (F. Krief)
1er Workshop WISc, Wireless Internet Services, 2008, Qatar (D. Négru)
Session spéciale “Réseaux, QoS et Sécurité” de la conférence AQTR 2008, Roumanie (D. Négru)

4.9.5 Evaluation
- Président du comité d’évaluation CNRS du PRISM (Versailles) 2005 (R. Castanet)
- Président du comité d’évaluation AERES du LORIA (Nancy) 2008 (R. Castanet)
- Président du comité d’évaluation AERES du GRIMAG (Guadeloupe) 2009 (C. Chaumette)
- Evaluation de demandes de subvention au CRSNG (Canada) depuis 2006 (F. Krief)
- Membre de la commission d’évaluation du RNTL (Réseau National Technologies Logicielles de 2001 à 2005 (R. Castanet)
- Membre du comité d’évaluation de l’ANR Defis, 2008 (C. Consel)
- Membre du comité d’évaluation de l’ANR ARPEGE, 2009 (C. Consel)
- Membre du comité d’évaluation AERES du PRISM (Versailles) 2008 (R. Castanet)
- Membre du comité d’évaluation AERES du MIPS (Mulhouse) 2008 (F. Krief)
- Expert dans le cadre du Programme Interne aux Instituts Carnot (P2IC) 2007 (F. Krief)

4.9.6 Rapporteur d’HDR ou de thèse étrangères
- Q. Zhang, University of London, 2007 (S. Chaumette, rapporteur)
- L. Hogie University of Luxembourg, 2007 (S. Chaumette, rapporteur)
- J. Midtgaard, University of Aarhus, 2007 (C. Consel, examinateur)
- L. Maalej Frikha, Ecole Supérieure des Communications de Tunis, 2008 (F. Krief, rapporteuse)
- A. Ben Letaifa, Ecole Supérieure des Communications de Tunis, 2007 (F. Krief, rapporteuse)

4.10 Annexe B: Jurys

4.10.1 Habilitations (but LaBRI)
- L. Vu, Université Paris, 2007 (F. Krief, rapporteuse)
- O. Dugeon, INPT Toulouse, 2008 (R. Castanet, examinateur)
- D. Geniet, Université de Poitiers, 2005 (R. Castanet, examinateur)
- I. Parissis, Université Joseph Fourier, Grenoble, 2007 (R. Castanet, examinateur)
- P. de Saqui-Sannes, INPT Toulouse, 2005 (R. Castanet, examinateur)
- P.E. Moreau, Institut National Polytechnique de Lorraine, 2008 (C. Consel, examinateur)
- M. Sudholt, Université de Nantes, 2007 (C. Consel, examinateur)
- S. Frenot, INSA Lyon, 2008, France (S. Chaumette, examinateur)
- M. Dalmot, Université de Pau, 2008 (S. Chaumette, examinateur)
- P. Roose, Université de Pau, 2008 (L. Reveillère, examinateur)

4.10.2 Thesis (but LaBRI)
- G. Lestiennes, Université d’Orsay, 2005 (R. Castanet, examinateur)
- C. A. Pachon, Une approche basée sur les modèles pour le test de robustesse, Université Joseph Fourier de Grenoble, 2005. (R. Castanet, examinateur)
- C. Bonan, Université Rennes 1, 2006. (R. Castanet, examinateur)
- T. Sadani, INPT-Toulouse, 2007 (R. Castanet, examinateur)
- C. Grepet, INT EVRY, 2007 (R. Castanet, examinateur)
- E. Araujo Rodrigues Vieira, INT Evry, 2007 (R. Castanet, examinateur)
- V. Darmiaillaq, Université Grenoble 1, 2007 (R. Castanet, examinateur)
- H. Thalmensy, Université Toulouse, 2007 (R. Castanet, examinateur)
- A. Desmoulin, Université Rennes 1, 2007 (R. Castanet, examinateur)
- C. Constant, Université Rennes 1, 2008 (R. Castanet, examinateur)
- F. Alberti, Université Paris 7, 2005 (C. Consel, examinateur)
- F. Jouault, Université de Nantes, 2006 (C. Consel, examinateur)
- N. Salatge, Institut National Polytechnique de Toulouse, 2006 (C. Consel, examinateur)
- G. Bobeff, Ecole des Mines de Nantes, 2006 (C. Consel, examinateur)
- D. Bromberg, Université de Versailles, 2006 (L. Reveillère, examinateur)
- A.E. Ozcan, Université de Grenoble, 2007 (C. Consel, examinateur)
- F. Baligaud, Université de Nantes, 2008 (C. Consel, examinateur)
- C. Noguera, Université de Lille 1, 2008 (C. Consel, examinateur)
- K. Mazouzi, University de Franche-Comté, 2005 (S. Chaumette, rapporteur)
- Y. Pigné, University du Havre, 2008 (S. Chaumette, rapporteur)
- C. Teyssie, Université Paul Sabatier, 2005 (F. Krief, rapporteuse)
- E. Lavinal, Université Paul Sabatier, 2006 (F. Krief, rapporteuse)
- A. Millet, Université Paul Sabatier, 2006 (F. Krief, rapporteuse)
- D. Darche, Université Henri Poincaré, 2006 (F. Krief, rapporteuse)
- R. Chahine, ENST, 2006 (F. Krief, rapporteuse)
- W. Louati, ENST, 2007 (F. Krief, examinatrice)
- S. Ould Cheikh El Mehdi, Université Paris 13, 2007 (F. Krief, rapporteuse)
- R. Nassrullah, Université de Technologie de Troyes, 2007 (F. Krief, Présidente)
- N. Marsit, Université Paul Sabatier, 2007 (F. Krief, examinatrice)
- N. Kettaf, Université de Haute Alsace, 2008 (F. Krief, rapporteuse)
- B. Mathieu, Université Pierre et Marie Curie, 2008 (F. Krief, rapporteuse)
- F. Shebli, Université de Valenciennes et du Hainaut Cambrésis, 2008 (F. Krief, rapporteuse)
- M. Salhani, Institut National Polytechnique de Toulouse, 2008 (F. Krief, rapporteuse)
- S. Fouladgar, Université Pierre et Marie Curie et Institut National des Télécommunications, 2008, (F. Krief, présidente du jury)
- D. Espes, Université Paul Sabatier, 2008 (F. Krief, rapporteuse)
- M. Nafaa, Université d’Evry val d’Essonne, 2009 (F. Krief, rapporteuse)
- N. Kobeissy, Université Pierre et Marie Curie et Institut National des Télécommunications, 2008, (F. Krief, rapporteuse)
- N. Tao, Ecole Nationale de l’Aviation Civile et Université Toulouse, 2009 (F. Krief, rapporteuse)
- F. Nivor, Université Paul Sabatier, 2007 (F. Krief, rapporteuse)

4.10.3 Prix
- Membre du jury du prix de thèse SPECIF 2005-2008 (C. Consel)
- Membre du jury du prix de thèse de l’Association ACM-SIGOPS de France (ASF) 2008 (C. Consel, L. Reveillère)

4.11 Annexe C: Collaborations
4.11.1 Conventions or international cooperations
- Amigo ; IP6 ; 2004-2007
- ENTHRONE1 ; IST IP ; 2004-2006
- ENTHRONE2 ; IST IP ; 2007-2009
4.11.2 Joint publications

- R. Boutaba; University Of Waterloo (Canada); publication
- P. Cointe; Université de Nantes (Nantes); publication, contrat
- F. Guidicci; Valoria (Vannes); contrat
- F. Guinand; LITIS - Le Havre contrat, publication
- A. Jamalipour; Université de Sydney (Australie); publication
- S. Jamin; Ann Arbor University (Etats-Unis)); publication
- A. Karmouch; University of Ottawa (Canada); publications, accueil d'étudiant
- J. Lawall; University of Copenhague (Danemark); publication
- A.F. Le Meur; LIFL (Lille); publication
- K. Meith; University of London (Royaume-Uni); publication, accueil d'étudiant à Londres
- J. Neuman De Souza; Federal University of Ceará (Brésil); publication
- C. Pu; Georgia Institute of Technology (Etats-Unis); publication
- D. Sauveron; XLIM (Limoges); contrat, publication
- S. Tabbane; Sup’Com (Tunisie); co-tutelle de thèse
- A. Nafaa; Univ. College of Dublin (Irlande); publication
- G. Kormentzas; Demokritos (Grèce); publication
- A. Mehaoua; Université Paris 5; publication, cotutelle thèse
- Qui; Univ. Evry (Paris); co-tutelle de thèse
- P. Lauren; GRTC (Colmar); publication
- H. Soldano; LIPN (Paris); publication
- G. Muller; Ecole des Mines de Nantes & INRIA Regal; publication

4.11.3 Others

- O. Barais; IRISA (Rennes)
- N. Ibrahim; INSA (Lyon)
- F. Le Mouël; INSA (Lyon)
- A. Ksentini; INRIA (Rennes)
- P. Bellot; Telecom Paristech & CNRS LTCI-UMR 5141 (Paris)
- A. Wei; IRIT (Toulouse)

4.11.4 Guests

- B. Goldberg; New York University, (Etats-Unis); 2007 (1 month)
- P. Hudak; Yale University (Etats-Unis); 2007 (1 month)
- J. Lawall; University of Copenhagen (Danemark); 2005 (4 months)
- G. Necula; University of Berkeley, (Etats-Unis); 2005 (1 month)
- S. Bhatia; Princeton University, (Etats-Unis); 2007 (1 month)
- J. Lawall; DIKU, University of Copenhagen, (Danemark); 2007 (1 month)
- T. Ekman; University of Oxford, (Royaume-Uni); 2008 (1 month)
- H. Jacob; Technische Universität Darmstadt (Allemagne); 2008 (1 month)
- A.M. Sloane; Macquarie University (Australie); 2008 (1 month)
- Y. Berbers; Katholieke Universiteit Leuven (Belgique); 2009 (1 week)
- R. Campbell; University of Illinois at Urbana-Champaign, (Etats-Unis); 2009 (1 week)

4.11.5 Invitations

- Jérémie Albert : University of Ottawa (Canada); 2009 (3 weeks)
- David Bromberg : University of Copenhagen (Danemark); 2009 (2 weeks)
- Damien Cassou : University of Bern (Suisse); 2008 (1 month)
-- Charles Consel : University of Freiburg (Allemagne) ; 2005 (1 week)  
-- " : Georgia Tech, Atlanta (Etats-Unis) ; 2005 (3 weeks)  
-- " : Columbia University (Etats-Unis) ; 2006 (1 month)  
-- " : AT&T Labs Research, New Jersey, (Etats-Unis) ; 2006 (1 month)  
-- " : Georgia Institute of Technology (Etats-Unis) ; 2006 (1 month)  
-- " : Macquarie University (Australie) ; 2007 (1 month)  
-- " : University of Princeton, (Etats-Unis) ; 2008 (1 month)  
-- " : University of British Columbia, (Canada) ; 2008 (1 month)  
-- " : University of Utah (Etats-Unis) ; 2008 (1 month)  
-- Zoë Drey : University of Aarhus (Danemark) ; 2009 (2 months)  
-- Laurent Réveillere : University of Copenhague (Danemark) ; 2009 (2 weeks)

4.12 Annexe D: Contracts and valorisation

4.12.1 Institutional contracts

-- Projet Services Robustes pour Réseaux Dynamiques ; Région Aquitaine ; 2003-2005  
-- Averroes ; RNTL ; 2003-2005  
-- COoSS ; ACI Sécurité ; 2003-2005  
-- DIAFORUS ; ANR AF ; 2008-2011  
-- DiscoGrid ; ANR CIGC ; 2006-2009  
-- IP-SIG ; RNRT ; 2003-2005  
-- Language Families for Systems Families ; ARC INRIA ; 2006-2009  
-- Sarah ; ANR SSIA ; 2005-2008  
-- SWAN ; RNRT ; 2003-2005  
-- TESTEC ; ANR LG ; 2008-2010  
-- WebMov ; ANR LG ; 2008-2010

4.12.2 Industrial contracts

-- EUROCONTROL ; Optimisation du trafic aérien par utilisation de modèles de théorie des graphes ; 2004-2006  
-- France telecom ; HomeSIP : development of a SIP-based middleware for home automation ; 2008-2010  
-- Thales ; Designing techniques and tools for developing domain-specific languages for Industrial, CIFRE ; 2005-2008  
-- Thales ; A Platform for the Development of Robust Multimedia Applications in Mobile Terminals, CIFRE ; 2006-2009  
-- Thales ; Integrating non-functional properties in an Architecture Definition Language and its execution environment, CIFRE ; 2008-2011  
-- Thomson ; Convergence of multiservices heterogeneous for home and extended-home networks ; 2008-2011  
-- Orange Labs (CRE) ; Etude et spécification d’architecture de réseaux autonomes. Application à la supervision de services multimédia sur réseau IP ; 2008-2011  
-- CNES ; Hybridiation satellite avec des réseaux maillés de capteurs ; 2008-2008  
-- Thales Alenia Space ; Apport et complémentarité des satellites avec d’autres technologies terrestres émergentes ; 2006-2007  
-- Viotech Communications ; Etude et mise en place de plate-forme multiservice embarquée pour la gestion de flux multimédia et de capteurs réseaux à différents niveaux logiciels et matériels, vers la création d’un réseau domestique "Multi-Play" ; 2009-2011  
-- RATP ; Méthodologie de test de robustesse pour les transports urbains ; 2005
4.12.3 Patents

- Procédé de routage intégré dans une fédération de réseaux personnels, 2007, membres du laboratoire : T. Ahmed
- Gestion d’une communication dans un réseau hétérogène, 2008, membres du laboratoire : T. Ahmed

4.12.4 Other software

- Plate-forme Calife ; démarche de dépôt envisagée
  Plate-forme pour le traitement des automates temporisés (ou p-automates), construite autour d’un bus logiciel sur lequel sont connectés des prouvers, des vérificateurs, des générateurs de test.
- TGSE ; démarche de dépôt envisagée
  C’est un logiciel de simulation, d’émulation et de génération de test de systèmes à contraintes temporelles. Issu des thèses d’Ismael Berrada et Patryk Chamuczynski. Utilisation restreinte dans les universités Bordeaux 1, La Rochelle et Goettingen.
- Network manipulator (Nem) ; démarche de dépôt envisagée
  Nem est un générateur, un analyseur et un convertisseur de topologies réseaux. Le générateur est capable de créer des réseaux qui suivent les lois puissances qui gouvernent la topologie de l’Internet.
- Network cartographer (Nec) ; démarche de dépôt envisagée
  Nec est un outil de cartographie IP de l’Internet qui fait appel à des serveurs traceroute distribués autour du globe afin d’avoir une vision non biaisée de l’Internet.
- Shaadhoc ; dossier de dépôt constitué auprès de l’Université
  Shaadhoc permet de partager un document entre des utilisateurs équipés de terminaux mobiles communicants. Il fournit un système de verrous distribués assurant un fonctionnement cohérent quoi qu’il advienne dans le réseau.
- JCATools ; dossier de dépôt constitué auprès de l’Université
- FSOnCard ; dossier de dépôt constitué auprès de l’Université
  FSOnCard est un système de fichiers virtualisé dans une carte à puce, permettant de stocker de manière sécurisée des données sur des points de montage locaux ou distants.
- DiaGen ; démarche de dépôt envisagée
  DiaGen est un générateur de framework de programmation qui utilise en entrée une description d’un système d’informatique ubiquitaire, écrite avec le langage dédié DiaSpec.
- Pantagruel ; démarche de dépôt envisagée
  Pantagruel est un langage visuel de programmation d’applications d’informatique ubiquitaire. Il est composé d’un éditeur graphique et d’un compilateur vers la plate-forme DiaSpec.
- DiaSim ; démarche de dépôt envisagée
  DiaSim est un simulateur d’applications ubiquitaires. Il est composé d’un éditeur et d’un simulateur. L’éditeur permet une édition graphique des simulations.

4.13 Annexe E: Thesis and HDR of the team

4.13.1 Habilitations

4.13.2 Thesis

- E. Atallah (S. Chaumette) : Authentification et échanges sécurisés dans une flotte nomade
- L. Barrere (S. Chaumette) : Etude et proposition de services dans le cadre de réseaux mobiles de type MANet
- B. Benmammar (F. Krief) : La gestion dynamique de la qualité de service dans les réseaux IP mobiles
- I. Berrada (R. Castanet) : Contribution au test de systèmes communicants
- S. Bhatia (C. Consel) : Optimisation de compilateurs optimistes pour les systèmes réseaux
- L. Burgy (C. Consel) : Approche langage au développement du support protocole d’applications réseaux
- A. Casteigts (S. Chaumette) : Contribution à l’algorithme distribué dans les réseaux mobiles ad hoc - Calculs locaux et rééquitages de graphes dynamiques
- E. Chauveau (R. Castanet) : Contribution à l’ingénierie du risque logiciel
- M. Diouf (R. Castanet) : Spécification et mise en œuvre d’un formalisme de règles métier
- I. Djama (F. Krief, T. Ahmed) : Adaptations inter-couches pour la diffusion des services vidéo sans fil
- F. Ferchaud (R. Castanet, C. Gavoille) : Optimisation de la gestion de flux aérien
- P. Grange (S. Chaumette) : Systèmes distribués : transparence, masquage et outils associés
- U. Javaid (F. Krief, T. Ahmed) : Routing and Mobility Management Strategies in Personal Networking Environments
- I. Jemili (R. Castanet) : Clusterisation et conservation d’énergie dans les réseaux ad hoc à grande envergure
- W. Jouve (C. Consel) : Approche déclarative pour la génération de canevas logiciels dédiés à l’informatique ubiquitaire
- A. Karray (S. Chaumette) : Conception, mise en œuvre et validation d’un environnement logiciel pour le calcul sécurisé sur une grille de cartes à puce
- J. Lancia (C. Consel) : Infrastructure orientée service pour le développement d’applications ubiquitaires
- F. Latry (C. Consel) : Approche langage au développement logiciel : Application au domaine des services de téléphonie sur IP
- M. Mackaya (R. Castanet) : Test des protocoles et services liés à la mobilité
- N. Mbarek (F. Krief) : Autonomie dans les réseaux : Négociation du niveau de service de bout en bout dans un framework de gestion autonome
- M. Mustaq (F. Krief) : QoS Provisioning for adaptive video streaming over P2P Networks
- N. Palix (C. Consel) : Langages dédiés au développement de services de communications
- F. Saad Korchef (R. Castanet) : Contribution au test de robustesse

4.13.3 Jointly advised thesis

- P. Chamucyzuski, Université de Goettingen, 2006-2009 (R. Castanet et D. Hogrefe (Goettingen)) : Algorithms and data structures for parametric analysis of real time systems
Team

Models and algorithms for Bio-informatics and information visualisation
(MABIOVIS)

Head: G. MELANÇON

Activities:

- **Theme** Algorithms for analysis of biological structures
  Head: P. FERRARO
  Keywords: Multiscale graphs, Compression, Tree edition distance and comparison, Secondary RNA structure, Plant structure, Discrete fractal analysis

- **Theme** Comparative genomics, modelling and analysis of biological data
  Head: D. SHERMAN
  Keywords: Comparative genomics, Protein interactions, Heterogeneous data integration, Stochastic multiscale modeling, Biological processes, Biological networks

- **Theme** Visualisation of very large data sets
  Head: D. AUBER
  Keywords: Information Visualisation, Massive Data, Databases, Graph drawing, Graph algorithmics, Interactive Graph Visualization

- **Team-Project** Magnome
  Head: D. SHERMAN
  Keywords: Systems biology, Genomics, Stochastic multiscale modeling, Biological processes

- **Team-Project** Gravité
  Head: G. MELANÇON
  Keywords: Graph Visualization, Graph drawing, Data mining
5.1 Members
(at 31st of August 2009)

T₁: Theme Algorithms for analysis of biological structures
T₂: Theme Comparative genomics, modelling and analysis of biological data
T₃: Theme Visualisation of very large data sets
E₄: Team-Project Magnome
E₅: Team-Project Gravité

5.1.1 Permanent faculty

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Total ETPC²: **10.5**  
(PR: 4  MCF: 9  CR: 2  IGR: 2)

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¹ Restricted to (vice-)presidents and (deputy-)directors of school, laboratory, department, and of international relationships.

² Equivalent Temps Plein Chercheur.
## 5.1.2 Temporary personnel

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<td>Gilbert, F.</td>
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<td>Bouklit, M.</td>
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Total ETPC: **12.3**

### 5.1.3 Personnel under industrial contract

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<td>Sallaberry, A.</td>
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Total ETPC: **0.2**

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1. *Prorata temporis.*
CHAPTER 5. TEAM MABIOVIS

5.2 Research summary

The MABioVis team (Modèles et algorithmes pour la bioinformatique et la visualisation), officially initiated in March 2006 and approved by the “Comité d’Evaluation” and Section 07 of the CNRS National Committee, is being evaluated for the first time in 2009.

The team presently gathers 15 researchers and university staff: 4 professors, 9 assistant professors and 2 full time CNRS researchers (sections 07 and 22). A university professor (CNU section 65) and two assistant professors (CNU sections 27 and 64/65), affiliated with Université Victor Segalen Bordeaux 2 (Life and Health Sciences) are full members of LaBRI and contribute to the activities of our team. Our team also benefits from the help of two research engineers (permanent staff).

Fundamental questions in the life sciences can now be addressed at an unprecedented scale through the combination of high-throughput experimental techniques and advanced computational methods from the computer sciences. The new field of computational biology or bioinformatics has grown around intense collaboration between biologists and computer scientists working towards understanding living organisms as systems. MABioVis addresses this challenge through the development of informatic techniques for multi-scale modeling and large-scale comparative genomics: data models for knowledge representation, stochastic hierarchical models for behavior of complex systems, algorithms for genome analysis, and data mining and classification. Our research program builds on our experience in comparative genomics, data-mining and classification, and formal methods for multi-scale stochastic modeling of complex systems. As a consequence, a majority of our activities are directly related to research issues in biology and bioinformatics. The results we obtained and the strong links we developed with collaborators from life sciences shows we have kept our promises. Our team contributes to the development and study of formalisms, models and algorithms answering both biological questions and improving on bioinformatics state-of-the-art.

Members of our team were founders of the Centre de Bioinformatique de Bordeaux (http://cbi.labri.fr). Our activities naturally develop in close collaboration with life sciences and bioinformatics researchers affiliated with regional institutes (Universities and Higher Education Schools and laboratories – Universités et EPST). Biology thus appears as our main application domain, although we also have potential interactions with other areas such as the analysis of sequential structures (text, sequences), or visual analytics and mining of complex data.

By nature our team is involved in multi-disciplinary actions and a major part of our research is funded through national or European grants. MABioVis also takes part in transfer technology actions towards both the industry and other scientific areas.

5.2.1 Scientific goals

Biology thus act for us as a target application domain and as a central subject of study. A large part of our work aims at understanding the evolution of genomes and their role in the living, and at different scales (biochemical, sub-cellular and cellular levels). To answer these questions, our team develops multiscale models and algorithms, integration of heterogeneous data and graph visualization. Our goals and aims are complementary, respective to each other but also because they offer complementary solutions to a same problem.

- Part of our work directly deals with biological data (genome description, study of metabolomic data, biological network reconstruction, etc.).
- Part of our work is concerned with objects from discrete mathematics modeling biological entities, and with the study of combinatorial properties shared by these objects (multiscale tree graphs, graph hierarchies, permutations and forbidden patterns, etc.).
- Finally, we aim at building systems integrating algorithms and techniques we develop, to help explore and analyze complex data, offering specialists an interactive and rich working environment. Tangible examples of this effort can be measured by looking at softwares developed and maintained by our team, and distributed to our research community (see [Rs22, Ca52, Ca80, Ca5, Rs2], for instance).
Figure 5.1 – Data Analysis, Algorithms and Modeling occur, interact and refine, within an iterative process going from data production to hypothesis building and validation.

These goals all enter an iterative loop typical of bioinformatics projects (Fig. 5.1). A number of projects require to produce and/or collect data, followed by a phase where data is annotated and enriched – collecting relevant data from heterogeneous data sources is a challenge in itself to which we have contributed solutions [Rs7, Rs17]. This data then act as input for algorithms. Experts most often get a feedback from these algorithms and analytical techniques through a visualization combining input data and output signals or results. Models are then elaborated based on this analysis. Observe that, after all, this iterative process is described linearly here although the algorithms, visual representations and models interact and are incrementally developed and refined.

The European projects ProteomeBinders [Rs41]3, bilateral FR/ANR–UK/BBSRC SysTryp4 or national Génolevures (GDR CNRS / ACI IMPBio) [Rs33]5 in which our team is involved each embody this framework.

Our team produces, relies and exploits results from fundamental research conducted at LaBRI – a number of our members were actually members of LaBRI founding teams (formal methods, combinatorial mathematics, graph theory). As a matter of fact, the scope of our research and the applicability of a number of our results go beyond the strict arena of bioinformatics, and concern other domains such as social network analysis or complex systems modeled as graphs. In the same vein, our research on text algorithmics gave birth to a LaBRI transversal project6 (together with collaborators from the “Image et Son” team).

In a sense, although we are closely concerned with biological data, our methodology is to abstract ourselves from this context and transpose the original questions into discrete mathematics and computer science problems: permutations and forbidden patterns, multiscale tree graphs, planar graphs, small word networks, etc.

3. See the URL www.proteomebinders.org.
5. Voir l’URL www.genolevures.org
6. See the presentation of the SIMBALS project.
Research summary – conclusion

Overall, our team has kept the promises made when created four years ago, in terms of scientific projects that were launched and results that were obtained. Our activities are now clearly visible at an international level, as shown by the selectivity of our publications and our involvement in national and European projects. A tangible proof certainly is the Génolevures project, which stands as one of our best achievements.

5.2.2 Results

Our team has obtained many original results published in high quality journals and international conferences. We now sum up the results we obtained by providing examples covering our research and emphasizing methodological aspects of our work.

Multiscale models, comparison and visualization of combinatorial biological structures

Secondary RNA structures and tree edit distance analysis The function of RNAs in the cell has intimate links with their spatial conformation. It is crucial to be able to compare RNAs from this point of view in order to establish whether they participate to a same biological function, for instance. Part of our work focused on RNAs’ secondary structures which can be described in the 2D plane. While the primary structure of RNAs are given as sequences of nucleotids, their secondary structure takes into account the folding of the molecule caused by biochemical bonds.

The study of the secondary structures clearly allows to describe them as being governed by tree patterns. When seen as graphs, they are planar; that is, they can be drawn on the plane without having edge crossings (edges correspond here to amino-acid bonds). Exploiting the underlying tree pattern, we were able to design a fully automated drawing algorithm approaching the traditional hand-drawn diagrams used in biology [Rs6]. This algorithm has also been embedded in collaborative environments [Cs4, Ca23]. Modeling the underlying tree pattern simultaneously using four trees provided an efficient multiscale description of these structures at various levels of details. The highest level (coarsest) describes the overall organization of loops – the molecule skeleton; the lowest (finest) level encodes the nucleotides of the sequence. This model allows for efficient comparison algorithms [Ca2], based on tree edit distance and/or on sequence analysis and comparison (text analysis). We have obtained significant results in this area during the past four years [Rs13, Ca75, Ca82, Rs15].

Applications to other domains The text analysis techniques we developed in the context of sequence comparison and alignment were successfully applied to the analysis of musical sequences [Ca75, Cs13, Cs1, Cs8, Cs18, Ra44] (this work was done in collaboration with members of the “Image et Son” team). Also, graph comparison heuristics were applied to image and video analysis [Cs6, Ca28, Rs10, Rs11]. Whether (and how) these techniques and algorithms can be transferred from multimedia to bioinformatics still has to be addressed.

Multiscale tree graphs and self-similarity Multiscale modeling is now recognized as central in plant modeling. A state-of-the-art report on methods for comparing plant structures [Cs15] allowed us to further develop original algorithms to compare multiscale tree graph structures [Rs29, Ra34]. These results have had an impact on plant modeling since the comparison of individual plants opened perspectives to evaluate simulation models for plant growth.

This work actually relies on a deep and long term work around the notion of self-similarity in tree graph structures and its link with botanics [Cs10, Rs16, Rs20] (see also [Ra16]).

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7. Every research paper we published will not be individually cited here. We suggest that the reader consult our complete list of publications.

Comparative genomics and modeling

**Genome rearrangement algorithms** We developed an improved algorithm, SyDIG, for identifying synteny in distant genomes. It is designed for widespread cases where existing methods, such as filtered genome alignments (e.g. GRIMM-Synteny), or profile-based iterated search (e.g. i-AdHoRe), do not work. This in turn has led to improvements in our method for identifying super-blocks of syntenic segments, improving on and building a bridge between competing methods defined by Sankoff and by Bourque and Pevzner. Super-blocks represent the semantics of the ancestral architecture, and provide a piecewise approximation to this architecture that provides a reasonable upper bound on the sum of rearrangement distances between contemporary genomes and the theoretical median. Super-blocks have been successfully identified for a range of species in the Hemiascomycetous yeasts.

Using a new formulation in terms of optimization, we devised a new algorithm, FAUCILS, using techniques from optimization by local search and metaheuristics. The algorithm maintains a population of configurations, modified depending on the set of architectures, and evaluated using the rearrangement distance. The result is a robust approach that converges rapidly, and obtains better results that those reported elsewhere. Compared with competing algorithms currently used, this new algorithm takes only a few minutes, compared to several hours; does so on tens of genomes, compared to a maximum of three; and includes biological constraints such as centromere presence and gene super-block conservation, which competing algorithms do not. A follow-up to FAUCILS uses swarming to identify pairwise rearrangement scenarios.

**Large scale genome annotation** Using our whole genome annotation pipeline (defined by David Sherman and Tiphaine Martin), we have successfully realized a complete annotation and analysis of four new genomes, provided to the Genolevures Consortium by the Centre National de Séquençage - Genoscope (Evry) and by the Washington University Genome Sequencing Center (St. Louis, USA). This result required a year of work by a network of 20 experts from 6 partner labs, using the Magus web-based system for collaborative genome annotation, and hundreds of hours of computation on our dedicated 54-core computing cluster. The analysis of these results, performed by members of the Consortium, include identification of 17 500 novel genes, genome comparative cartography and breakpoint analysis, assessment of protein family-specific phylogenetic trees and fast-evolving genes, and definition of a molecular clock through characterization of families of homologous and orthologous protein-coding genes. This major result was published in *Genome Research*.

**Data-mining and data integration** Finding meaningful patterns in biological data is the main challenge that we address. We have developed an unique knowledge base containing a comprehensive description of a large set of eukaryote genomes, with focus on the relations between objects described using ontological tools [Rs7]. We have also developed novel methods for representation of biological knowledge and data, and their integration in a format allowing their confrontation, thus offering new analysis perspectives of biological phenomenons. We are able to address gene set enrichment analysis using guilt-by-association methods. By using and extending such methods, in collaboration with KEGG members, we have presented a new approach for metabolic analysis that allows us to observe the transcriptional activity of metabolic functions at the genome scale.

We have developed new data-mining methods for some specific challenges in comparative genomics, including a novel consensus clustering algorithm that provides an efficient approximation in low-order polynomial time to this NP-complete problem. The algorithm uses a compact coding of the confusion matrix to efficiently identify conflict regions, resolved conflicts using a Condorcet election procedure and relaxation of the problem to computation of a maximal inexact set cover [Rs34]. It performs well in applications to protein family definition, accurately clustering data over a nonuniform distribution of evolutionary distances [Rs33, Au27, Rs30]. This algorithm was validated on previous and gold-standard datasets, and applied on a large scale to cluster 725 × 10^6 pairwise gene relations obtained from systematic homeomorphic and nonhomeomorphic Blast and Smith-Waterman alignments. The resulting analysis formed the basis for a large-scale
identification of orthologues and primary homologues in the genomes annotated by the Génolevures Consortium.

**Biological networks** In biological systems analysis, we focus on definitions of modularity in metabolic networks. Definitions of modularity that have been proposed in the literature are defined from a topological, structural or functional point of view [Rs26]. Modularity appears as a key ingredient in the design of fully automated drawings of metabolic pathways allowing their interactive exploration [Rs8, Ca16]. We also develop methods and algorithms to help locate (search algorithms, interactive exploration) and assess of various patterns (motifs) in metabolic networks [Rs40].

A number of results we have obtained focus on the visualization and interactive exploration of networks in general, with a special focus on small world and scale-free networks which appear as useful models in bioinformatics. Methods and algorithms have been designed to interact with large hierarchies of nested graphs [Ca18, Ca20, Rs4, Cs2].

By integrating expression and regulation data, we try to suggest a formal and global definition of the modularity concept by reconciling structural and functional modules within networks.

We are also interested in flux balance analysis to simulate the dynamic metabolic network and to understand impacts of biological constraints.

**Modeling and formal methods** Constructing mathematical models of cell behavior is a key step in industrial applications mapping genotype to phenotype. We continue to develop the BioRica high-level modeling framework [Ca80], that integrates discrete and continuous multi-scale dynamics within the same semantics domain, while offering an easy to use and computationally efficient numerical simulator. BioRica is a stochastic dataflow extension of the AltaRica framework, developed in the Formal Methods team of the LaBRI. BioRica programs are hierarchical and are based on a generic formalism that captures a range of discrete and continuous formalisms and admits a precise operational semantics. BioRica models have a corresponding compositional semantics in terms of an extension of Generalized Markov Decision Processes. BioRica is a modeling and simulation software platform which was recently accepted as a INRIA technology development action (ADT).

**Modeling through genome comparison** Using comparative genomics to inform mathematical models of cell function is a central challenge of the MAGNOME research program. Emmanuelle Beyne developed *in silico* methods for predicting protein complexes, one form of protein-protein interaction that provide the building blocks of cell machinery. These predictions were compared to experimental results from gel electrophoresis. This work was extended in a large-scale experimental study using quantitative proteomics and expression data, during a long-term visit to Prof. Steve Oliver’s lab at Cambridge University. Florian Iragne has refined his methods for subtractive modeling of biochemical pathways, using his algorithmic framework for policy-directed graph extraction to identify cases of pathway loss through search for correlated gene losses. Nicolás Loira has used a large dataset of protein families from the Génolevures complete genomes and sub-partitioned it through clustering methods to obtain reliable indications of enzyme conservation in nine species. The resulting determination of enzyme conservation is mapped to biochemical reaction models and used to infer stoichiometric models that are currently being evaluated through comparison with experimental results produced by Prof. Nicaud’s group at AgroParisTech.

**New senescence models** Hayssam Soueidan, in collaboration with Marija Cvijovic of MPI Berlin, extended her work on models for yeast senescence to a new hierarchical model that, through exhaustive exploratory simulation, was used to characterize the fitness space of strategies for transmission of damaged proteins from mother to daughter cells. Many complex biological processes of this kind, such as the cell division cycle, involve replicative behaviors where a process can evolve and create another process. Since the initial values of the latter depend on the process state of the
former, simulation of such hierarchical systems requires parameter computation and estimation at simulation time.

To this end, we exploited the object-oriented nature of BioRica models by using parallel composition and node instantiation to describe dynamical hierarchical systems, thus minimizing the extra work that must be performed by the modeler to transform a single-cell model into a hierarchical system. This enriched model allowed for the prediction of previously uncomputable behaviors. Simulation data agree with experimental data obtained by Thomas Nyström’s group (Göteborg).

5.3 Highlights

5.3.1 CBMI 2007 Best Student Paper Award

Fanny Chevalier working under the supervision of Maylis Delest and Jean-Philippe Domenger (team Image et Son) has been awarded the Best Student Paper Award [27] at the CBMI 2007 International Conference for her work on object retrieval in video content based on visual graph mining. CBMI is a yearly international conference bringing together the various communities involved in the different aspects of Content-Based Multimedia Indexing. It is the main international forum for the presentation and discussion of the latest technological advances, industrial needs and product developments in multimedia indexing, search, retrieval, navigation and browsing.

5.3.2 Génolevures

Génolevures A major release of the Génolevures web resource (genolevures.org, cbi.labri.fr/Genolevures), representing more than 20 person-months of work in collaboration with partners from the biological sciences, came on line at the end of the year 2008 [?]. The resource contains 78,000 pages of detailed information for genetic elements, 21,000 families of annotated protein coding genes, and high-quality datasets made available to the community by the Génolevures Consortium. In 2007, a large-scale deployment of the Magus web-based genome annotation system (now integrated into the Génolevures web system) was used by a network of 20 experts to completely analyze and annotate four complete genomes. A total of 17 500 new genes were identified, and 48 000 genes were completely classified in our data warehouse using our consensus clustering methods.

5.3.3 Tulip

The Graph Visualization Framework Tulip is one of the best software achievements of our team.9. The framework now benefits from ten years experience in software development and user feedback, and gathers a growing number of users each year. The software is downloaded close to 1000 times per month and we are now able to track around 50 actual users each day from all over the world. Tulip goes beyond the simple experimental platform it used to be and is a major ingredient to transfer our technology and results towards other scientific disciplines and the industry (see [Ca5, Ou1], for instance).

CHAPTER 5. TEAM MABIOVIS

5.4 Visibility

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5.6 Collaborations, contracts and valorization

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For world map, see Figure 1.2.
### 5.7 Thesis and HDR

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5.8 Publications of the team MABIOVIS

5.8.1 Summary

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Be reminded that all the publications listed here under the category Journals and the vast majority of those listed under the category Conferences and Books (and many of those listed under the category Other) are publications of Rank A as defined by the AERES. Indeed, it is the team that has chosen the journals and the conferences that are highlighted with the label Selection in order to put emphasis on certain publication media, and in no case does this imply the declaration of the complement of this selection as being of lower quality.

5.8.2 Journals [ACL]

(journals with editorial board registered by AERES or by international data bases)

Selection


[Rs7] R. Barriot, D. J. Sherman, and I. Dutour, How to decide which are the most pertinent overly-represented features during gene set enrichment analysis, BMC Bioinformatics, 8 (2007). [inria-00202721]


5.8.3 Conferences [INV, ACTI, ACTN]

(invited conferences, international or national conferences with proceedings)

Selection


Invited
(invited speaker in international or national conferences)


**Other**


[CA40] P. Durrens, M. Nikolaou, and D. Sherman, Gene fusion and fission events in fungus genomes, in 8th International Symposium on Lactic Acid Bacteria (LAB8), 2005.


5.8.4 Books [08, 0V]

(Scientific book or chapter)


5.8.5 Other publications [ACLN, ASCL, COM, AFF, DO, AP]

(revues without review process, oral contribution without proceedings, poster, editorial board, registered software, translations, guides and technical reports, intermediate reports for large project)


BIBLIOGRAPHY – MABIOVIS


[Au26] G. Jean, Reconstruction and visualization of genome rearrangements within the kluyveromyces, in First German / French / European Meeting on Yeast and Filamentous Fungi, 2008.


5.9 Annexe A: Visibility

5.9.1 Editorial board, invited editor

- The Electronic Journal of Combinatorics (M. Delest, éditrice depuis 1994)
- revue I3 (Cépaduès), G. Melançon (éditeur depuis 2008)

5.9.2 Steering committee

- Coordinateur français et membre du comité exécutif du projet européen INFRASTRUCTURE ELIXIR, depuis 2007 (A. de Daruvar)
- PCPintGIS IBISA GRISBI- Grille pour la bioinformatique, depuis 2008 (T. Martin)

5.9.3 Program committee

- ACM Symposium on Software Visualization, 2008, Munich, Germany (D. Auber)
- CompBioNets’05, Lyon, France (A. de Daruvar)
- IDA’05, Intelligent Data Analysis, 2005, Madrid, Espagne (S. Maabout)
- IDA’07, Intelligent Data Analysis, 2007, Ljubljana, Lettonie, Slovenie (S. Maabout)
- IEEE InfoVis’06, Baltimore, Etats-Unis (G. Melançon)
- IEEE InfoVis’07, Sacramento, Etats-Unis USA (G. Melançon)
- IEEE InfoVis’08, Columbus, Etats-Unis (G. Melançon)
- IEEE InfoVis’09, Atlantic City, Etats-Unis (G. Melançon)
- IEEE Pacific VisInternational Conference on Visualization, 2010, Taipei, Taiwan China (D. Auber)
- Workshop Modern Computer tools for the biosciences A Grid Perspective, 2008, Lyon, France (A. de Daruvar)
- IEEE/Eurographics EuroVis, 2009, Berlin, Allemagne (G. Melançon)
- International Symposium on Graph Drawing 2006, Karlsruhe, Allemagne (G. Melançon)
- International Conference Computer Graphics, Imaging and Visualization, 2009, Tianjin, Chine (G. Melançon)
- Jobim’08, Journées Ouvertes de Bio-informatique et de Matéhmatiques, Lille, France (P. Ferraro)
- KVD’07, Knowledge Visualization and Knowledge Discovery, Gratz, Autriche (B. Pinaud)
- WABI’09, Workshop on Algorithms in Bioinformatics, University of Pennsylvania, USA (M. Nikolski)
- BDA’05, Bases de données avancées, 2005, Rennes, France (S. Maabout)
- BDA’09, Bases de données avancées, Namur, Belgique (S. Maabout)
- Biograle’08, Bioinformatique à grande échelle, Lyon, France (T. Martin)
- Démarche qualité au sein des plateformes de bioinformatique, 2007, Bordeaux, France (A. de Daruvar, T. Martin)
- EGC’08, Conférence nationale Extraction et Gestion de Connaissances, Nice, France (D. Auber)
- CP Kick-off GRISBI- Grille pour la bioinformatique, GIS IBISA, 2009, Lyon France (Tiphaine Martin)
5.9.4 Conference organization

- JOBIM’06, Journées Ouvertes de Bio-Informatique et Mathématiques, Bordeaux (E. Bon, A. de Daruvar, I. Dutour, P. Ferraro, T. Martin)
- Workshop ESF (co-organisateur avec E. Chevet), 2007, Bordeaux, France (A. de Daruvar)
- Atelier intégration omics, 2008, Bordeaux, France (A. de Daruvar)
- Atelier qualité plateformes bordelaises, 2008, Bordeaux, France (A. de Daruvar)
- ComBioNets 2005, , Lyon, France (P. Thébault)
- Démarche qualité au sein des plateformes de bioinformatique, 2007, Bordeaux, France, (A. de Daruvar, T. Martin)
- GRISBI- Grille pour la bioinformatique, GIS IBISA, 2008, Lyon France (Tiphaine Martin)
- Journée satellite OGSB’06, Bordeaux, France (I. Dutour)
- 4e Rencontres Internationales en Analyse Statistique Implicative, 2007, Castellon, Espagne (B. Pinaud)

5.9.5 Evaluation

- Présidente du comité d’évaluation AERES du LIFL 2008 (M. Delest)
- Présidente du comité d’évaluation de l’ANR, Masses de données 2005 et 2006 (M. Delest)
- Coordinateur du réseau national des plateforme de bioinformatique (ReNaBi) 2006-2008 (A. de Daruvar)
- Expert pour des propositions NSF (Etats-Unis) 2008 (G. Melançon)
- Membre Comité Stratégique Génopole Pasteur depuis 2008 (A. de Daruvar)
- Participation à la préparation de la Roadmap nationale sur les infrastructures pour le Ministère 2007 (A. de daruvar)
- Membre du Conseil Scientifique de la Génopole Toulouse, depuis 2007 (A. de Daruvar)
- Membre du comité exécutif du GDR CNRS 3003 Bioinformatique Moléculaire, depuis 2006 (A. de Daruvar)
- Membre du comité d’évaluation AERES du CAMS 2009 (M. Delest)
- Membre du comité d’évaluation de l’ANR Masses de données 2007 (G. Melançon)
- Membre nommé du comité national CNRS section 7 depuis 2008 (M. Delest)
- Membre du comité d’évaluation de INRIA Program Biological Systems (BIO A) 2005 (A. de Daruvar)
- Membre nommé de la section CNU 27 Informatique (Guy Melançon)
- Membre du comité de pilotage et du comité technique de GRISBI- Grille pour la bioinformatique, GIS IBISA, 2008-2010, Lyon France (T. Martin)
- Membre suppléant du Comité Consultatif Régional de Recherche et de Développement Technologique (CCRRDT) de la Région Aquitaine, Commission 3 Sciences biologiques, médicales et de la santé depuis 2007 (D. Sherman)
- Membre du CNU section 65, 2005-2008 (A. de Daruvar)

5.9.6 Rapporteur d’HDR ou de thèse étrangères

- Hannes Pretorius, 2008, Computer Science Department, T/U Eindhoven Pays-Bas (G. Melançon, Examinateur)
5.10 Annexe B: Jurys

5.10.1 Habilitations (but LaBRI)

- J.D. Fekete (LRI Orsay, Université Paris Sud, 2005) (G. Melançon, Examinateur)
- Christine Brun (IBDM Marseille, University Luminy Marseille, 2007, (A. de Daruvar, rapporteur)

5.10.2 Thesis (but LaBRI)

- Catherine Bru (INRA, Université Toulouse 1, 2005) (A. de Daruvar, rapporteur)
- Géraldine Pascal (AGC, Université d’Evry-Val d’essonne, 2005) (A. de Daruvar, examinateur)
- Laure Vescovo (SUPELEC Gif, Université d’Evry-Val d’essonne, 2007) (A. de Daruvar, rapporteur)
- Nicolas Jauniaux (SUPELEC Gif, Université d’Evry-Val d’essonne, 2008) (P. Durrens, examinateur)
- Antony Le Béchec (INSERM U620, Université Rennes 1, N. Théret, 2007) (I. Dutour, Rapporteur)
- Julien Lavergne (Laboratoire d’informatique, Univ Tours, 2008) (G. Melançon, rapporteur)
- Jean Villerot (EERIE, Ecole des Mines d’Alès, 2008) (G. Melançon, rapporteur)
- Nicolas Ferey (LIMSI, Rachid Gherbi, 2006) (G. Melançon, rapporteur)
- Mohammad Ghoniem (LINA, Ecole de Mines de Nantes, 2006) (G. Melançon, rapporteur)
- Christophe Tricot (LISTIC, Université de Chambéry, 2006) (G. Melançon, rapporteur)
- Nathalie Henry (LRI Orsay, Université Paris Sud, 2008) (G. Melançon, Président)
- Matthieu Defrance (LIFL, Université Lille 1, 2006) (D. Sherman, examinateur)

5.10.3 Prix

- Membre du Jury de thèse SPECIF 2003-2005 (M. Delest)
- Membre du Jury de thèse ASTI 2009 (G. Melançon)

5.11 Annexe C: Collaborations

5.11.1 Conventions or international cooperations

- COFFTemblor; FP6 Intact; 2005-2009
- COFFELIXIR; FP7 Infrastructures; 2007-2010
- COFFGénolesures; GDR; 2004-2009
- COFFGRISBI; GIS IBISA; 2008-2010
- Réseau d’excellence européen Evoltree; FP6 NOE; 2006-2010
- YSNB; FP6 RTN; 2005-2009
- ProteomeBinders; FP6 CA; 2006-2010
- PORGY; Kings college London (Royaume-Uni); 2008-2009
- Algorithms for music analysis; Kings college London (Royaume-Uni); 2007-2009

5.11.2 Joint publications

- C. Chauve; University Simon Fraser (Canada); publication
- A. Denise; Université Paris-Sud Orsay (Paris); publication
- J.B. Durand; Université Joseph Fourier & INRIA (Grenoble); publication
5.11.3 Others

- A. Danchin; Institut Pasteur (Paris)
- T. Joos; Naturwissenschaftlichen und Medizinischen Institutunmi (Allemagne)
- J.L. Souciet; Université Louis Pasteur, S. Potier,
- H. Westerhauss; Vrije universiteit (Hollande)
- E. Westhof; Institut de Biologie Moléculaire et Cellulaire (Gif-sur-Yvette)
- P. Wincker; Génoscope (Paris)

5.11.4 Guests

- J. Abello; Rutgers University (Etats-Unis); 2007 (1 month)
- S. Brlek; Université du Québec à Montréal (Canada); 2008-2009 (6 months)
- C. Chauve; Simon Fraser University (Canada); 2008 (1 month)
- Y. Chiricota; Université du Québec à Chicoutimi (Canada); 2007 (1 month)
- M. Cvijovic; Max Planck Institute (Allemagne); 2007 (1 week), 2008 (1 week)
- M. Dejongh; College Hope Holland (Etats-Unis); 2009 (5 months)
- T. Gibson; EMBL Heidelberg (Allemagne); 2007 (1 month)
- A. Nikolskaya; Georgetown University (Etats-Unis); 2007 (1 month)
- H. Purchase; University of Glasgow (Royaume-Uni); 2009 (1 month)
- A. Telea; Groningen University (Hollande); 2007 (1 month), 2008 (6 months)
- N. Vyahhi St. Petersburg State University (Russie)2008 (1 months), 2009 (2 months)

5.11.5 Invitations

- Julien Allali : Kings College (Royaume-Uni); 2007 (1 week)
- “ : Mac Master University (Canada); 2008 (1 week)
- David Auber : University of British Columbia (Canada); 2005 (1 month), 2006 (1 month)
- Emmanuelle Beyne : Cambridge University (Royaume-Uni); 2007 (1 month), 2008 (1 month)
- “ : Institut Pasteur, Paris; 2006 (1 week)
- “ : Université de Strasbourg (Strasbourg); 2006 (1 week)
- “ : Université Louvain-La-neuve (Belgique); 2006 (1 week)
- “ : AgroParisTech (Paris); 2006 (1 week)
- Pascal Ferraro : projet INRIA Virtual Plants (Montpellier); 2007 (1 week), 2008 (1 week)
- “ : Université de Calgary (Canada); 2006-2008(2 years)
- “ : Kings College (Royaume-Uni); 2007 (1 week)
- “ : University of Auckland (Nouvelle -Zélande); 2007 (1 week)
- “ : University Simon Fraser (Canada); 2007 (1 week), 2009 (1 week)
5.12 Annexe D: Contracts and valorisation

5.12.1 Institutional contracts
- ENTICE; appel d’offre Usages de l’Internet; 2004-2006
- Animation Scientifique ACI Masses de données; ACI MD; 2004-2007
- ARena; ACI IMBPLO; 2005-2007
- Arborescence pour l’étude de la structure et du développement des plantes; ACI NIM; 2004-2007
- Auto-Similarité Musicale; PEPS ST2I; 2008
- BlastSets; ACI IMBPLO; 2003-2006
- BRASERO; ANR Blanc; 2006-2009
- CUBE de données ; ACI Jeune Chercheur; 2004-2007
- Divoeni; ANR Biodiversité; 2008-2012
- EVOLMYCO; ANR GMGE AO; 2008-2010
- FIVE; ANR RNTL; 2006-2008
- Génolevures en Ligne ; ACI IMBPLO; 2003-2006
- GENARISE; ANR Blanc; 2005-2008
- GRISBI; GIS IBISA; 2008-2010
- MetaboP; ANR GEN-036, Genoplante; 2005-2007
- Metaprofile; AAP Alimentation et nutrition humaine; 2007-2009
- NOSSI; ANR Calcul Intensif et simulation; 2008-2010
- Présidence du Comité d’évaluation de Masse de Données ; ANR; 2006-2007
- Programme fédérateur INRA agroBI; INRA; 2006-2008
- Protic-WS; ANR Génoplante; 2007-2009
- Simbals ANR Blanc; 2006-2009
- SPANGEO; ANR MD; 2005-2008
- SYSTRYP; ANR BIOSYS; 2007-2010
- Tanguy; ANR CONTINT; 2008-2011

5.12.2 Industrial contracts
- RECORDS; Pôle AerospaceValley; 2008-2011
- Société PIKKO (Montpellier); convention de collaboration recherche; 2005,2007
- Société PIKKO (Montpellier); CIFRE; 2007-2010
- Société Rimant; convention de collaboration recherche; 2005
- France Telecom; convention de collaboration recherche; 2005-2006
- QTL levures œnologiques; Région Aquitaine et SARCO-Laffort; 2007-2008
- Société Genigraph (Toulouse); CIFRE; 2004-2007
- Société 2Moro (Bidart); Fouille de données hétérogènes distribuées, CIFRE; 2009-2012

5.12.3 Other software
- GVSR : gvsr.polytech.univ-nantes.fr
GVSR est un annuaire en ligne qui répertorie actuellement plus de 70 logiciels généraux ou
spécialisés de visualisation et manipulations de graphes. L’objectif de ce site est double : (i) permettre, lors d’une étape de découverte, à un utilisateur de naviguer dans la liste des logiciels du site pour lui permettre d’affiner l’expression de ses propres besoins, (ii) fournir avec une présentation uniforme des informations précises sur chacun des outils pour le guider dans son choix.

- Brasero : brasero.labri.fr
Le but de cette plateforme, développé principalement au LaBRI, est de fournir des outils à la fois efficaces et pertinents d’un point de vue biologique pour le problème essentiel de la comparaison d’ARN. Le projet inclut trois volets originaux : la conception de modèles combinatoires et d’algorithmes efficaces (issus de la théorie des graphes et de la combinatoire des arbres), la constitution de données de benchmarks pour l’évaluation et la validation sur des réelles problématiques biologiques, le développement de logiciels librement diffusés intégrant également des programmes originaux de visualisation. Ces travaux permettent de proposer des outils standards ayant vocation à devenir une référence dans la communauté.

- MiGaL : igm.univ-mlv.fr/ allali/migal
MiGaL est une méthode de comparaison de deux structures secondaires développée en C++. Chaque structure est représentée par quatre niveaux d’abstractions, chaque niveau étant un arbre enraciné ordonné. La comparaison se fait niveau par niveau, du plus abstrait au plus détaillé. La comparaison de deux niveaux repose sur un algorithme d’édition d’arbres. Le logiciel est diffusé librement et utilisable via une interface web qui est consultée régulièrement.

- Simbals QhH : simbals.labri.fr
La suite Simbals propose des systèmes d’estimation de la similarité musicale en se basant sur de nombreux critères, essentiellement musicaux, comme la mélodie, l’harmonie, la tonalité, le rythme, etc. L’une des applications majeures du système propose une nouvelle méthode de navigation dans une base de données musicales en utilisant des requêtes par fredonnement (query-by-humming), permettant de retrouver un morceau à partir d’un extrait fredonné, des morceaux ressemblant à un extrait donné, et ainsi de faciliter aux utilisateurs l’accès à de nouvelles pièces musicales. Simbals a été primé deux fois aux Mirex 2006 et 2007.

- OpenAlea : openalea.gforge.inria.fr
C’est un logiciel libre développé principalement par l’équipe INRIA Virtual Plants qui fournit un environnement de développement convivial aux modélisateurs des plantes et une plateforme avancée de déploiement de méthodes. OpenAlea permet aux chercheurs de construire leurs modèles à l’aide d’une interface visuelle et intuitive et proposent un ensemble de modèles et d’outils dédiés à la modélisation des plantes.

- Vlab : algorithmicbotany.org/vlab
Le Virtual Laboratory (Vlab) est une plateforme logicielle de modélisation des plantes, principalement développé à l’Université de Calgary, Canada. Vlab est composé : (a) de programmes de simulation basés sur les L-Systèmes (cpfg et lpfg), (b) d’un environnement de modélisation qui fournit les outils et l’interface graphique pour les manipulés, (c) et d’une librairie de programmes pour la simulation des processus environnementaux. Vlab a été déployé auprès d’environ 200 groupes de recherche à travers le monde.

- Tulip : www.tulip-software.org
Tulip est un logiciel permettant l’analyse visuelle de données. Il est tout particulièrement adapté à l’analyse de données relationnelles (graphe, web, réseau sociaux etc...). Développé au sein de LaBRI depuis 2001, ce logiciel possède une large communauté d’utilisateurs (1000 téléchargements chaque moi) et intègre la majorité des résultats de recherche du thème “Visualisation de l’information”.

- Magus : http://magus.gforge.inria.fr/
Magus est un système d’annotation de génomes eukaryotes, organisé sous forme de plateforme de collaboration Web et couramment utilisé par un réseau d’experts internationaux. Son originalité est de permettre l’annotation simultanée de génomes apparentés, grâce à des classifications de gènes homologues et de loci synténiques.

- Faucils :http://faucils.gforge.inria.fr
Faucils est une collection d’outils de reconstruction de génomes ancestraux, basée sur le
modèle Hannahalli-Pevzner et des algorithmes originaux de recherche local stochastique.

- **IntAct** [http://www.ebi.ac.uk/intact](http://www.ebi.ac.uk/intact)
  IntAct est une base de données fédérée européenne d’interactions entre protéines et d’autres biomolécules. Il comporte un site central et des nœuds locaux installés en entreprise, et un système de synchronisation qui met en œuvre des standards internationaux défini sous l’égide de la HUPO-PSI.

- **ProViz** : [cbi.labri.fr/proviz.htm](http://cbi.labri.fr/proviz.htm)
  ProViz est un logiciel de visualisation hautement interactive de réseaux biomoléculaires, combinant les ontologies et standards internationaux, des outils d’analyse intégrés avec IntAct, et la plateforme Tulip.

  Génolevures en Ligne fournit des outils de gestion et d’exploration d’une base de connaissance d’annotations génomiques. À la différence de logiciels semblables, le focus n’est pas mis sur les propriétés individuels mais sur les relations complexes entre gènes et protéine, qui sont organisés en réseaux et en classifications hiérarchiques.

- **BioRica** : [http://biorica.gforge.inria.fr/](http://biorica.gforge.inria.fr/)

- **Molligen** : [http://cbi.labri.fr/outils/molligen/](http://cbi.labri.fr/outils/molligen/)
- **BlastSets** : [http://cbi.labri.fr/outils/BlastSets/](http://cbi.labri.fr/outils/BlastSets/)
- **Mery** : [http://www.cbib.u-bordeaux2.fr/MERYB/Mery-B](http://www.cbib.u-bordeaux2.fr/MERYB/Mery-B)

### 5.13 Annexe E: Thesis and HDR of the team

#### 5.13.1 Thesis

- C. Gaugain (A. de Daruvar) : Exploration bioinformatique des relations entre mécanismes moléculaires et fonctions cellulaires, Université Bordeaux 2, 2007
- R.Barriot (S. Dulucq, I. Dutour) : Intégration des connaissances biologiques à l’échelle de la cellule
- E.Beyne (D. Sherman) : Règles de cohérence pour l’annotation génomique : développement et mise en oeuvre in silico et in vivo
- R.Bourqui (M. Delest, D. Auber) : Décomposition et Visualisation de graphes : Applications aux Données Biologiques
- F.Chevalier (M. Delest, J.P. Domenger) : Reconnaissance de motifs dans des graphes : heuristique et applications
- M. Diouf (R. Castanet, S. Maabout), Spécification et mise en oeuvre d’un formalisme de règles métier
- A.Don (M. Delest, J. Benois-Pineau, N. Hanusse) : Indexation et navigation dans les contenus visuels : approches basées sur les graphes
- C.Herrbach (S. Dulucq, D. Sherman) : Étude algorithmique et statistique de la comparaison des structures secondaires d’ARN
- F.Iragne (S. Dulucq, D. Sherman) : Prédiction de réseaux d’interactions biomoléculaires à partir de données de la génomique comparée
- G.Jean (S. Dulucq, M. Nikolski) : In silico methods for genome rearrangement analysis : from identification of common markers to ancestral reconstruction
- A.Ouangraoua (S. Dulucq, P. Ferraro) : Development of conceptual and algorithmical tools for the analysis of biological tree structures
5.13.2 Jointly advised thesis

- Daniel Archambault (T. Munzner, D. Auber), Feature-based graph visualization, Université of British Columbia, 2008

5.14 Annexe F: Scientific responsibilities

5.14.1 National

- GDR Génolevures; correspondant LaBRI David Sherman

5.14.2 Other

Team

Formal Methods

(MF)

Head: I. WALUKIEWICZ

Activities:

• Theme Informatics and linguistics
  Head: C. RÉTORÉ
  Keywords: Informatics and linguistics, automatic language processing, formal grammars, resource logic, linear logic, Lambek calculus, Lambda calculus.

• Theme Logics, graphs and languages
  Head: B. COURCELLE
  Keywords: Graph decomposition, recognisability, monadic second order logic, mu calculus, games, proof assistants, finite description of countable objects.

• Theme Modelling and verification
  Head: I. WALUKIEWICZ
  Keywords: Verification, synthesis, infinite state systems, concurrent systems, real-time, program logics, symbolic representations.

• Team-Project Signes
  Head: C. RÉTORÉ
  Keywords: Informatics and linguistics, automatic language processing, formal grammars, resource logic, linear logic, Lambek calculus, Lambda calculus.
6.1 Members
(at 31st of August 2009)

T₁: Theme Informatics and linguistics
T₂: Theme Logics, graphs and languages
T₃: Theme Modelling and verification
E₄: Team-Project Signes

6.1.1 Permanent faculty

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Total ETPC²: 23  ( PR: 8  DR: 2  MCF: 16  CR: 7  IGR: 2)

¹ Restricted to (vice-)presidents and (deputy-)directors of school, laboratory, department, and of international relationships.
² Equivalent Temps Plein Chercheur.
### 6.1.2 Temporary personnel

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Total\(^1\) ETPC: 24.2

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Total\(^1\) ETPC: 1.7

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1. Prorata temporis.
CHAPTER 6. TEAM MF

6.2 Research summary

The Formal Methods group\(^3\) is active in many areas of theoretical computer science and its applications. Its work is organized in three themes: Informatique Linguistique (IL), Logiques, Graphes et Langages (LGL), Modélisation et Vérification (MV). The group consists of 33 permanent researchers: 8 PR, 16 MdC, 2DR, 7CR. Due to the visibility of its members, and the quality of the obtained results it plays a significant role in France as well as internationally.

The group was created in 2005 from two former groups, L3A and MVTSI, together with the INRIA project SIGNES. Since 2005 it welcomed: 2 PR, 4 MdC, 3 CR CNRS, 1 CR INRIA, and very recently 1 DR CNRS. At the same period it was left by 2 PR and 1 MdC. The saddest of these departures was the premature death of Bertrand Le Saëc. A substantial number of CNRS and INRIA appointments, together with a number of non-permanent visitors, are one more indication of the attractiveness of the group.

The spectrum of scientific interests of the group is large. It is a center of expertise in language theory, automata theory, formal grammars, graph decompositions, combinatorics of monoids and groups, distributed systems, verification of infinite state systems, different kinds of logical formalisms: monadic second-order logic, linear logic, program logics. The group contributes to development of solid theoretical foundations for various application domains. This is clearly visible later in this text: in the presentation of prominent results as well as of substantial software projects developed in the group. Three high-quality weekly seminars are an important part of the life of the group. One should also mention the weekly seminar “Algorithmique distribuée” joint with group “Combinatoire et Algorithmique”.

The quality of the group members and the impact of the results they obtained is best attested by two IUF nominations in 2007 as well as by a large number of invited lectures at conferences\(^6,14\) and schools\(^6,14,3\). One can quote, among the most recent ones: FOSSACS’08, ICALP’08, EuroComb’09. The members of the group are editors of 8 high quality journals\(^6,8\) and were chairs of program committees of first-rate conferences\(^6,8\), such as: STACS’07, STACS’08, ICALP’08, ESSLLI’09. They are also coordinators of 2 GT of GDR programs\(^6,10\).

The group is involved in a significant number of national and international cooperations\(^6,10\). Locally, there are traditionally strong links with the group “Combinatoire Algorithmique” attested, among others, by the VISIDIA project and cooperations around graph labeling schemes. Active collaborations with the LSR and MaBioVis groups are formalised by joint projects and theses. The group collaborates with a majority of first-rate laboratories in France. In particular, it participated in about 15 projects of type ANR/ACI in the period of reference. The group has coordinated several bilateral projects, most notably an Indo-French network project. It has been one of the 8 sites of the EU-RTN programme GAMES, and it is now one of the three principal sites of the European Science Foundation Research Networking Programme GAMES, regrouping 12 European countries.

Involvement in organization and evaluation of scientific activity has been very considerable. The group was present in a remarkable number of program committees of major conferences\(^6,8\). It organized recently two major conferences (STACS’08, and ESSLLI’09) as well as several workshops\(^6,8\). The members of the group participated in the evaluation of laboratories and at other national committees\(^6,8\).

Collaboration with industrial partners is organized via ANR projects as well as through direct contracts\(^6,11\). The AltaRica project offers a modeling language and a set of tools, well-known in aero-space industry. In the period of reference the group coordinated 4 PhD thesis CIFRE (Airbus, EADS, TURBOMECA) and 17 master internships around this system. The VISIDIA project coordinated 3 thesis CIFRE (SERMA, EADS, 2MORO). There were also thesis CIFRE with EADS and SERMA in other contexts. Three ANR projects, SPACIFY, BINCOA, RIMEL, have direct collaborations with industry.

Educational activities on master and doctoral levels were also considerable\(^6,12\) (20 thesis). The members of the group have given lectures in several international summer schools\(^6,14,3\).

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3. This text gives a 5 page résumé of the activities of the group. More detailed summary of divided with division into themes can be found at [http://www.labri.fr/index.php?n=MF.MF](http://www.labri.fr/index.php?n=MF.MF)
They actively participated in establishing of master program at Pôle Universitaire Français in Ho Chi Minh, Vietnam. The group welcomed for internship a steady flow of ENS students as well as top rated Indian students from IIT.

The remaining part of this presentation describes some prominent results obtained by the group. Their nature reflects the strong tradition in developing solid foundations for applications; be it verification, linguistic, or distributed algorithms. With this end in mind, the group studies words, trees, and graphs from a variety of perspectives. These basic objects in computer science are used to model various phenomena such as the behaviour of a system, the structure of a sentence of a natural language, the topology of a network. The desire to manipulate and express properties of these objects leads to the theory of recognizability, logic, algebra, study of different forms of automata, theory of graph decompositions, proof theory. The acquired expertise is applied to tackle problems such as synthesis, verification of infinite state systems, syntactic and semantic analysis of natural languages.

**Recognizability.** Language theory is one of the corner stones of computer science. Algebra plays here a central role as it allows fine descriptions of language classes. For example, Schützenberger’s theorem gives a characterisation of first-order definable languages by the property of aperiodicity of their syntactic monoids. In consequence, it is decidable if a regular language is first-order definable. This theorem provided an important impetus for a development of a very fruitful approach of language theory. In contrast, till recently there was very little progress for classes of tree languages. Undoubtedly, a decidable characterization of EF languages, was one of the results that reopened interest in this subject. Subsequently, an algebraic theory of forest algebras has been developed which has been an important step allowing a big progress in this area of research in the last years.

**Combinatorics of monoids and groups** Effectiveness of solving equations in monoids and groups is a classical subject with many applications. The fundamental results of Makanin show the decidability of the problem for free monoids and free groups. In some other monoids the problem is undecidable. As we are very far from obtaining a full classification of monoids with respect to decidability, it is interesting to have transfer theorems saying that an operation on monoids or groups preserves decidability. Several important results of this type have been obtained. Whitehead minimization problem is another central algorithmic problem concerning groups (finding a minimum size element in the automorphic orbit of a word, a cyclic word or a finitely generated subgroup in a finite rank free group). The first fully polynomial algorithm to solve this problem was given, that is, an algorithm that is polynomial both in the length of the input word and in the rank of the free group.

**Pushdown automata** Paper provides an important extension of the fundamental result on decidability of DPDA equivalence. It shows decidability of bisimilarity between two equational graphs of bounded out-degree. This result generalises a number of decidability results concerning bisimilarity, for example for counter automata, or PDA without state. Iterated, or higher-order, stacks have regained interest in recent years. Paper gave a characterisation of recursive schemes of order 2 by such automata with an additional operation called “panic”. The result was later extended to all orders, and the operation itself remains a new important object of study. Automata with iterated stack have been also used to characterise recursive sequences of numbers giving surprising results and new methods. Among others, new characterisations of $N$-rational sequences have been obtained.

**Graph decompositions** Hierarchical graph decompositions are essential in algorithmics of finite structures. They also induce notions of algebra for graphs that in turn induce robust notions of recognizable and equational graph classes. Rank decomposition is a relatively new type of decomposition with very interesting properties. An algebra associated to this decomposition was developed for undirected, and directed graphs. Polynomial approximation algorithms by
Hlinený and Oum have been extended to directed graphs. The PhD thesis of M. Kanté containing these results has been awarded in 2009 the “prix de thèse” of Bordeaux University. While optimal tree decompositions are NP-complete to compute, paper [Rs41] gives polynomial algorithms for some graph classes. Whereas rank width and tree width at most \(k\) are defined by the existence of particular decompositions, duality theorems yield witnesses of the opposite, that is, combinatorial obstacles to existence of decompositions. A general framework to prove so called duality theorems has been proposed [Rs3]. The framework unifies known results and allows to prove new ones.

Expressiveness of MSOL

One of the most prominent results of the group has been the solution of a conjecture by Seese [Rs20]. It says that every set of graphs with decidable monadic second-order theory has bounded clique width. The result establishes an important link between logic and combinatorics. It uses a spectrum of tools : “vertex minors”, matroids, constructions coming from [Rs11].

Games and synthesis

Systems that interact with an environment can be often naturally modeled with games. Moreover, the synthesis problem can be usually reduced to finding a winning strategy in a game. In case of distributed systems, games in question are usually partial information games, sometimes with more than two players. Paper [Cs3] considers a difficult case of stochastic games of partial information. Even though the values of such games are not algorithmically computable, it shows that many other properties are. Moreover, it proves that these games are qualitatively determined, i.e. determined in terms of existence of strategies winning almost surely. In another line of research an extension of Ramadge and Wonham setting to nondeterministic processes was thoroughly investigated [Ou1]. A classification of decidable/undecidable cases was given. Although an extension of this setting to Mazurkiewicz traces is a notoriously difficult problem, some progress has been made [Cs24, Ou7].

Presburger arithmetic

The analysis of infinite state systems relies on the ability to express quantitative properties. Presburger arithmetic and automata recognizing binary encodings of numbers (NDD) are two prominent methods to do so. Both methods have their advantages and drawbacks, so it is very important to study the relationships between the two. Paper [Cs30] gives a major result in this area, namely it solves the problem of constructing in polynomial time a formula from a given NDD. The interest of this line of research was confirmed by the result saying that being a Presburger definable property is a structural property of NDD [Rs38].

Acceleration methods, FASTER and TaPAS

Acceleration is a method of computing (an over-approximation) of the set of the reachable states : for example states reachable by executions of a loop of a program. Several works [Ca15, Ra6, Ca68] introduced and studied the flat acceleration framework. Among others, it was shown that most of known classes of systems where acceleration is effective fall into this framework. The tool FAST implementing acceleration methods was extended to the more modular tool FASTER [Cs1]. In parallel a collection of programs for manipulating Presburger formulas, TaPAS, has been developed [Cs33]. In particular it contains an implementation of the algorithm for passing from an NDD to a Presburger formula described in the previous paragraph. Very encouraging experiments with TaPAS and FASTER promise new possibilities for solving Presburger formulas and using acceleration methods.

Type logical grammars and rewrite systems

Two kinds of formalisms may be used for describing natural language syntax : rewriting systems (usual grammars of strings or of trees) like minimalist grammars and categorial grammars like Lambek grammars where a derivation is a proof in a substructural logic. They have complementary advantages and drawbacks : grammars of the first kind have a rich generative capacity and allow efficient parsing algorithms while grammars of the second kind allow to compute semantic representation of analysed sentence. The team obtained several results connecting the two kinds of grammars, some of which made use of abstract categorial grammars. Such results include a faithful representation of minimalist grammars within
partially commutative linear logic [Au1], as well as of representation of the same grammars as an
abstract categorial grammar [Ca65]. Non associative Lambek grammars have also been proved to
be equivalent to and abstract categorial grammar of order two [Ca99]. This entails, among others,
that Lambek style analyses can be imported into abstract categorial grammars.

Towards a logic based model of lexical semantics  Formal models of natural language se-
mantics are rather poor and obscure when compared to models of its syntax. Montague semantics
is appealing from a formal viewpoint but cannot express relations among meanings. On the oppo-
site side, unstructured lexical semantics, in particular without argument structure, have no means
to compute the semantics of compound expressions. A kind of semantic lexicon has been propo-
sed [Rs5] as a refinement of Montague semantics: in addition to usual lambda terms expressing
its argument structure, the lexicon endow each word with several lambda terms that enables the
word to change its type and to be related to its other possible meanings. Second-order lambda
calculus is used to anticipate type changes depending on the types of other words. This provides
a correct algorithm for computing the meaning of compound expressions (qualia exploitation) or
the for predicting exactly the meanings corresponding to correct copredications and prohibiting
the impossible ones – thus going beyond what current models were able to do.

Grail  The Grail system is a multimodal categorial-grammar parser, that computes a typed
lambda term depicting the semantics of the analysed sentence. These terms are obtained from
proof nets that are proofs viewed as (hyper)graphs. This system is mainly devoted to spoken
Dutch (Dutch spoken corpus from NWO), and relies on a lexicon extracted from a one-million
word corpus with 130000 sentences annotated with syntactic graphs. Due to the size of the corpus,
the number of graphs associated to a word during the extraction process is sufficient to parse
large corpora. But, the number of graphs associated with most common words is quite big, and
the system makes use of statistical methods in order to find the most likely sequences of graphs,
and only the n best are analysed. Depending on the parameters, including n, the percentage of
words having a correct category varies between 81% and 98%. Grail is one of the most competitive
systems of syntax acquisition and deep parsing on a par with the one of Hockenmaier (Urbana-
Champaign). A similar system is being defined for french, using the annotated corpus from the
newspaper Le Monde.

AltaRica  The modeling language AltaRica has been designed in LaBRI at the end of 90-ties.
This language and an associated suite of tools became gradually well known in the industry. A
variant of the language is used in commercial tool OCAS developed by Dassault. It is also an
input language of the tool SIMFIA of EADS. Thales studied the use of this language and has
bought several licences of OCAS tool. Since 2005, AltaRica tools have been completely rewritten
using BDD technology. A new simulator and a new compiler to Lustre have been added [Au60].
In total, in the period of reference, there were 4 thesis CIFRE on this subject and 17 internships
master in the industry.

Highlights

- Two IUF nominations (one senior and one junior member since 2007). Invited talks at presti-
gious conferences and at several prestigious events: special events to honour Hubert Comon,
Gérard Huet, P.S. Thiagarajan, Wolfgang Thomas.
- GAMES project: till 2006 very successful RTN Networking Programme, since 2008 highly
visible ESF network regrouping 12 countries. At present LaBRI is one of the three main
coordinators. Timed-DISCOVERI: Indo-French research network between top French and
Indian laboratories.
- Organisation of two major conferences STACS ’08 and ESSLII ’09.
- In total 9 “thèses CIFRE” with various industrial partners.

Competitive examination  Awards
6.3 Visibility

<table>
<thead>
<tr>
<th>Conference:</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program committee chair</td>
<td>8 including 8 int’l</td>
</tr>
<tr>
<td>Program committee</td>
<td>28 including 28 int’l</td>
</tr>
<tr>
<td>Steering committee</td>
<td>7 including 6 int’l</td>
</tr>
<tr>
<td>Organization (conf, school, ...)</td>
<td>11 including 8 int’l</td>
</tr>
<tr>
<td>Editorial board</td>
<td>19 including 17 int’l</td>
</tr>
<tr>
<td>Evaluation (laboratories, projects, ...)</td>
<td>8</td>
</tr>
<tr>
<td>Committee membership</td>
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<td>External refereing (int’l)</td>
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6.4 Jurys

<table>
<thead>
<tr>
<th>Habilitation (but LaBRI)</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thesis (but LaBRI)</td>
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</tr>
<tr>
<td>Competitive examination</td>
<td>36</td>
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<tr>
<td>Award committee</td>
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</table>

6.5 Collaborations, contracts and valorization

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Joint publications</td>
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</tr>
<tr>
<td>Other</td>
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<tr>
<td>Guest</td>
<td>19</td>
</tr>
<tr>
<td>Invitation</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Institutional contracts</th>
<th>total</th>
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</thead>
<tbody>
<tr>
<td>Industrial contracts</td>
<td>15</td>
</tr>
<tr>
<td>Software pre-patented</td>
<td>5</td>
</tr>
</tbody>
</table>

For world map, see Figure 1.2.
### 6.6 Thesis and HDR

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDR LaBRI</td>
<td>3</td>
</tr>
<tr>
<td>Thesis LaBRI</td>
<td>15</td>
</tr>
<tr>
<td>Jointly advised thesis</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>3 foreigner</td>
</tr>
</tbody>
</table>

Including 3 foreigner
6.7 Publications of the team MF

6.7.1 Summary

<table>
<thead>
<tr>
<th></th>
<th>selection</th>
<th>invited</th>
<th>others</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journals</td>
<td>55</td>
<td>32</td>
<td></td>
<td>87</td>
</tr>
<tr>
<td>Conferences</td>
<td>42</td>
<td>25</td>
<td>107</td>
<td>174</td>
</tr>
<tr>
<td>Books</td>
<td>10</td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Other publications</td>
<td></td>
<td></td>
<td>71</td>
<td>342</td>
</tr>
</tbody>
</table>

Be reminded that all the publications listed here under the category Journals and the vast majority of those listed under the category Conferences and Books (and many of those listed under the category Other) are publications of Rank A as defined by the AERES. Indeed, it is the team that has chosen the journals and the conferences that are highlighted with the label Selection in order to put emphasis on certain publication media, and in no case does this imply the declaration of the complement of this selection as being of lower quality.

6.7.2 Journals [ACL]

(journals with editorial board registered by AERES or by international data bases)

Selection


Other


6.7.3 Conferences [INV, ACTI, ACTN]

(invited conferences, international or national conferences with proceedings)

Selection

(CAV, CONCUR, DISC, FOSSACS, FSTTCS, ICALP, ISAAC, IPDPS, LICS, PODC, RTA, SAS, SIAM Conference on Discrete Mathematics, STACS, TACAS, WG)


[Cs19] H. Gimbert and F. Horn, Simple stochastic games with few random vertices are easy to solve, in FOSSACS, 2009, pp. 5–19.


BIBLIOGRAPHY – MF


Invited
(invited speaker in international or national conferences)


BIBLIOGRAPHY – MF


[Cl14] I. WALUKIEWICZ, Pushing the limits of pushdown verification, in Perspectives in verification, workshop in honour of Prof. Dr. Wolfgang Thomas on the occasion of his doctorate Honoris Causa, 2005.

[Cl15] I. WALUKIEWICZ, From logic to games, in IFIP WG 2.2 40th Anniversary meeting, 2006.


[Cl22] P. WEIL, Algebraic extensions of finitely generated subgroups of free groups, in International Conference on Semigroups and Languages, 2005.


Other


[Ca73] O. Ly, R. Chen, and M. Bauberon, *Pullback grammars are context-free*, in 4th International Conference on Graph Transformation (ICGT’08), 2008.


6.7.4 Books [OS, OV]
(scientific book or chapter)


6.7.5 Other publications [ACLN, ASCL, COM, AFF, DO, AP]
(revues without review process, oral contribution without proceedings, poster, editorial board, registered software, translations and technical reports, intermediate reports for large project)


[Au5] H. Anoun, Towards a logical approach to nominal sentences analysis in standard araclic, in ESSLLI 2006 Student sessions, 2006. [hal-00409499]


[Au38] H. Gimbert, Randomized strategies are useless in Markov decision processes. 2005.


6.8 Annexe A: Visibility

6.8.1 Steering committee

- ESSLLI (European Summer School in Logic, Language and Information), C. Retoré (2007-2008)
- ICGT (International Conference on Graph Transformation), M. Mosbah
- GAMES (EU Research and Training Network), D. Janin, A. Muscholl, I. Walukiewicz
- GAMES (ESF Research Networking Programme), I. Walukiewicz
- MOVEP (MOdelling and VERifying parallel Processes), Sutre (2006, 2008)
- STACS (International Symposium on Theoretical Aspects of Computer Science), P. Weil, A. Muscholl
- JFLA Journées francophones des langages applicatifs, P. Castéran (2005 à 2009)

6.8.2 Editorial board, invited editor

- Discrete Mathematics and Theoretical Computer Science : A. Muscholl (editor since 2002), P. Weil (depuis 1996)
- Fundamenta Informaticae : I. Walukiewicz (editor since 2007)
- La Gazette des mathématiciens Retoré (editor since 2008)
- Information Processing Letters : A. Muscholl (editor since 2008)
- Information and Computation : B. Courcelle (editor since 1992)
- LIPIcs “Leibniz International Proceedings in Informatics” : P. Weil (editor since 2009)
- Logical Methods in Computer Science : B. Courcelle (editor since 2005)
- Theoretical Informatics and Applications : P. Weil (editor since 2008)
- Groups, Complexity and Cryptography : P. Weil (editor since 2007)
- Special Issue FOSSACS’04, eds. I. Walukiewicz (Theoretical Informatics and Applications, Vol. 39 No. 3 (2005))
- Proceedings of STACS’07, eds. W. Thomas, P. Weil
- Special Issue STACS’07, eds. W. Thomas, P. Weil, (Theory of Computing Systems, à paraître)
- Proceedings of STACS’08, eds. S. Albers, P. Weil
- Special Issue STACS’08 , eds. S. Albers, P. Weil, (Theory of Computing Systems, à paraître)
- Proceedings of ICALP’08, eds. L. Aceto, I Damgard, L.A. Goldberg M. Halldorsson A. Ingolfsdottir, I. Walukiewicz
- Special Issue ICALP’08, eds. G. Castagna, I. Walukiewicz (Logical Methods in Computer Science, à paraître)
- Technique et Science Informatiques : A. Griffault (editor since 2009)
- Traitement Automatique des Langues : C. Retoré (editor since 2001, editeur in-chief since 2004)

6.8.3 Program committee

- STACS’07, (co-presidence Weil) ; Symposium on Theoretical Aspects of Computer Science
- STACS’08, (co-presidence Weil) ; Symposium on Theoretical Aspects of Computer Science
- ICALP’08, (presidence track B Walukiewicz) ; International Colloquium on Automata, Languages and Programming
- ESSLLI’09, (co-presidence Moot) ; European Summer School in Logic, Language and Information
- CRISSIS’09, co-presidence (co-presidence Mosbah) ; International Conference on Risks and Security of Internet and Systems
- JSM’06, (co-presidence Retoré) ; Journées de sémantique et modélisation
- GCM’06, (co-presidence Mosbah) ; Workshop on Graph Computation Models
- GCM’08, (co-presidence Mosbah); Workshop on Graph Computation Models
- CIAA’09; Conference on Implementation and Application of Automata
- CRISIS’08; International Conference on Risks and Security of Internet and Systems
- CONCUR’05 ’06 ’08; International Conference on Concurrency Theory
- CSL’07, 09; Annual Conference on Computer Science Logic
- DLT’09; International Conference on Developments in Language Theory
- ELS’08, 09; European Lisp Symposium
- ESSLLI’05; European Summer School in Logic, Language and Information
- FOSSACS’05, 06, 08; Foundations of Software Science and Computation Structures
- FSTTCS’05, 09; Foundations of Software Technology and Theoretical Computer Science
- FCT’09; International Symposium on Fundamentals of Computation Theory
- FG’08, 09; Conference on Formal Grammar
- HLT-EMNLP’05; Human Language Technology Conference Conference on Empirical Methods in Natural Language Processing
- HTL-NAACL’06, 09; North American Chapter of the Association for Computational Linguistics - Human Language Technologies Conference.
- ICALP’06, 08, 09; International Colloquium on Automata, Languages and Programming
- ICGT’08; International Conference on Graph Transformation
- IJCNLP’09; International Joint Conference on Natural Language Processing
- LICS’05, 07; IEEE Symposium on Logic in Computer Science
- LACL’05; Logical Aspects of Computational Linguistics
- MFCS’05, 06; International Symposium on Mathematical Foundations of Computer Science
- MOL’07; Mathematics of Language
- OPODIS’08; International Conference On Principle Of Distributed Systems
- PODS’08; Principles of Database Systems
- SOFSEM’09; Current Trends in Theory and Practice of Computer Science
- SECRYPT’09, International Conference on Security and Cryptography
- TALN’06 09; Traitement Automatique des Langues Naturelles
- TCS’08; IFIP International Conference on Theoretical Computer Science

6.8.4 Conference organization

- LACL (International Conference on Logical Aspects of Computational Linguistics), Bordeaux, 28-30 avril 2005
- MOVEP (MOdelling and VERifying parallel Processes), Bordeaux, Juin 2006
- AltaRica (Troisième AltaRica Workshop), Bordeaux, 27-28 novembre 2007
- STACS ’08 (International Symposium on Theoretical Aspects of Computer Science Bordeaux), Février 2008
- Workshop AutoMath (A Developments and New Tracks in Trace Theory), Cremone 9-11 Octobre 2008
- Dagstuhl seminar (Beyond the Finite : New Challenges in Verification and Semistructured Data), Dagsuhl, 2008
- Workshop Automata, Concurrency and Timed Systems, Chennai, janvier 2009
- ESSLLI ’09 (European Summer School in Logic, Language and Information 2009), Bordeaux, 20-31 Juillet 2009
- JSM-ALSLN (Atelier logique et sémantique du langage naturel), Bordeaux, 27-29 mars 2006
- JSM (Journées Sémantique et Modélisation), Bordeaux, 30-31 mars 2006
- Journées GDR IM GT Jeux, Bordeaux, mai 2008

6.8.5 Evaluation

- Evaluation du laboratoire :LIF 2007, (C. Retoré)
- Evaluation du laboratoire :IRISA 2007, (P. Weil)
6.8.6 Rapporteur d'HDR ou de thèse étrangères

- Christof Loeding, HDR, (RTW Aachen, 2009) (I. Walukiewicz)
- Tomasz Jurdzinski, HDR, (Wroclaw University, 2009) (I. Walukiewicz)
- Manfred Kufleitner, Thèse, (Stuttgart, 2006) (P. Weil)
- Roberto Bonato, Thèse, (Verona, 2006) (C. Retoré, G. Sénizergues)
- Nicole Hondausch, Thèse, (Stuttgart, 2006) (G. Sénizergues)
- Laura Giambruno, Thèse, (Palermo, 2007) (P. Weil)
- Matteo Capelletti, Thèse, (Utrecht, 2007) (R. Moot)

6.9 Annexe B: Jurys

6.9.1 Habilitations (but LaBRI)

- Isabelle Tellier (Lille 2005) (C. Retoré)
- Serge Burckel (St Denis de la Réunion, 2005) (B. Courcelle, G. Sénizergues)
- Stéphane Demri (ENS Cachan 2007) (I. Walukiewicz)
- Luigi Santocanale (LIF, 2008) (I. Walukiewicz)
- Patricia Bouyer (LSV Cachan, 2008) (A. Muscholl)
- Malika More (LAIC Clermont-Ferrand), 2008 (A. Muscholl)

6.9.2 Thesis (but LaBRI)

- Benjamin Lerman (LIAFA, 2005) (M. Zeitoun, I. Walukiewicz)
- Sébastien Bardin (LSV Cachan), 2005 (G. Sutre)
- Berke Durak (Paris, 2005) (G. Sénizergues)
- Nicolas Baudru (LIF Marseille, 2005) (A. Muscholl)
- Arnaud Carayol (IRISA, Rennes, 2006) (I. Walukiewicz)
- Hugo Gimbert (LIAFA, 2006) (I. Walukiewicz)
- Nathalie Bertrand (ENS Cachan, 2006) (I. Walukiewicz)
- Raphaël Michel (LIUPPA, 2006) (P. Weil)
- Erwan Moreau (Nantes, 2006) (C. Retoré)
- Sylvain Degeilh (Montpellier, 2006) (C. Retoré)
- Jacques Klein (IRISA, 2006) (A. Muscholl)
- Rémi Eyraud (St Etienne, 2006) (G. Sénizergues)
- Sylvain Schmitz (Nice, 2007) (Sénizergues)
- Christophe Crespelle (Montpellier, 2007) (B. Courcelle)
- Julien Cabessa (LIAFA et Université de Lausanne, 2007) (P. Weil)
- Fabrice Chevalier (LSV, 2007) (P. Weil)
- Laura Chaubard (LIAFA, 2007) (P. Weil)
- Alexandre Duret-Lutz LIP6(2007) (A. Griffault)
- Véronique Moreau (Toulouse, 2007) (C. Retoré)
- Jean-Baptiste Raclet , IRISA, Rennes, 2007 (A. Dicky)
- Walid Belkhir (LIF, 2008) (I. Walukiewicz, B. Courcelle)
- David Soguet (Orsay, 2008) (B. Courcelle)
- Celine Raynal (Paris, 2008) (C. Retoré)
- Sebastien Hinderer (Nancy, 2008) (C. Retoré)
APPENDIX – MF

– Florian Horn (RWTH Aachen, 2008) (A. Muscholl)
– Arnaud Sangnier (LSV Cachan, 2008) (M. Zeitoun)
– Tristan Le Gall (IRISA, 2008) (G. Sutre)
– Rodrigo de Souza (Paris, 2008) (G. Sénizergues)
– Stéphane Leroux (ENS Lyon, 2008) (C. Castéran)
– Frank Sablé (Paris, 2008) (C. Retoré)
– Jamil Ahmad (IRCCyN, 2009) (G. Sutre)
– Marc Autord (Caen, 2009) (G. Sénizergues)
– Achille Frigeri (Paris et Milan, 2009) (G. Sénizergues)

6.9.3 Prix
– E.W. Beth Prize (prix de thèse international sur logic, language and information) (Retoré : 2005)

6.9.4 Concours

6.10 Annexe C: Collaborations

6.10.1 Conventions or international cooperations
– GDR Informatique et Mathématiques ; A. Muscholl responsable GT Jeux
– GDR Génie de la Programmation et du Logiciel ; Pierre Castéran co-responsable GT Langages TYpes et Preuves
– GDR Jeux Théorie des Jeux : Modélisation Mathématique et Applications ; plusieurs membres dans l’équipe
– GDR GPL Formalismes et Outils pour la Vérification et la Validation ; plusieurs membres dans l’équipe.
– GDR Sémantique et modélisation ; plusieurs membres dans l’équipe.
– Timed-DISCOVERI ; Bilatéral France-Inde ; 2005-2008
– Automata and free groups ; Bilatéral France-Espagne ; 2007-2008
– Automata, profinite semigroups and symbolic dynamics ; Bilatéral France-Portugal ; 2006-2007
– GAMES ; Réseaux européens RTN ; 2002-2006 ; 8 pays européens
– GAMES ; ESF Research Networking ; 2008-2012 ; 12 pays européens

6.10.2 Joint publications
– J. Almeida (Porto) ; co-publication
– D. Berwanger (Aix-La-Chapelle) ; Co-publication
– B. Boigelot (Liège) ; co-publication
- M. Bojanczyk (Varsovie); co-publication
- J. Blumensath (Darmstadt); co-publication
- J. Costa (Braga); co-publication
- A. Dawar (Cambridge); co-publication
- T. Deis (Nebraska, USA); co-publication
- V. Diekert (Stuttgart); co-publication
- J. Duparc (Lausanne); co-tutelle
- Z. Esik (Szeged); co-publication
- F. Fomin (Bergen); co-publication
- E. Graedel (Aix la Chapelle); co-publication
- T. Knapik (Nouvelle-Calédonie); co-publication
- S. Lasota (Varsovie); co-publication
- M. Lohrey (Leipzig); co-publication
- J. Meakin (Nebraska, USA); co-publication
- A. Murawski (Oxford); co-publication
- A. Myasnikov (Montréal); co-publication
- A. Middeldorp (Insbrück); co-publication
- D. Niwinski (Varsovie); co-publication
- L. Ong (Oxford); co-publication
- S. Oum (Corée); co-publication
- A. Roig (Barcelone); co-publication
- T. Schwentick (Dortmund); co-publication
- P. Silva (Porto); co-publication
- A. Twigg (Oxford); co-publication
- P. Urzyczyn (Varsovie); co-publication
- E. Ventura (Barcelone); co-publication

6.10.3 Others
- Aix la Chapelle (E. Graedel, W. Thomas)
- Barcelone (E. Ventura, G. Morrill)
- Boston (H. Straubing)
- Chennai (K. Lodaya, M. Mukund, N. Kumar)
- Corée du Sud (S. Oum)
- Darmstadt (A. Blumensath)
- Haïfa (J. Makowsky)
- Insbruck (A. Middeldorp)
- Lausanne (J. Duparc)
- Leipzig (D. Kuske, M. Lohrey)
- Liège (B. Boigelot)
- Lincoln, Nebraska (J. Meakin)
- Leiden (J. Engelfriet)
- Los Angeles (E. Stabler)
- Munich (H. Seidl)
- Oxford (A. Twigg)
- Porto (J. Almeida, P. Silva)
- Roma (M. Abrusci)
- St Petersbourg (Y. Matiyasevich)
- Stuttgart (V. Diekert)
- Szeged (Z. Esik)
- Tokyo (M. Kanazawa)
- Utrecht (M. Moortgat)
- Vérone (D. Delfitto)
- Warsaw (D. Niwinski, M. Bojanczyk)
6.10.4 Guests
- Jorge Almeida; Porto (Portugal); 2006 (1 month), 2007 (1 month)
- Dietmar Berwanger; Université (Allemagne); 2005 (1 month), 2006 (1 month)
- Bernard Boigelot; Liège (Belgique); 2005 (1 month); 2 weeks 2005
- Mikolaj Bojanczyk; Varsovie (Pologne); 2009 (1 month)
- Vaclav Brozek; Brno (République tchèque); 2008 (1 month)
- José Carlos Costa; Braga (Portugal); 2006 (1 month), 2007 (1 month)
- Denis Delfito; Université de Verona (Italie); 2008 (2 months)
- Annegret Habel; Université d’Olbdenburg (Allemagne); 2008 (1 month)
- Marcia Jurdzinski; Warwick (Grande-Bretagne); 2008 (1 month)
- Greg Kobele; Berlin (Allemagne); 2006 (1 month), 2007 (1 month)
- Manfred Kufleitner; Stuttgart (Allemagne); 2006 (1 month), 2007 (1 month)
- Dietrich Kuske; Univ. Leipzig (Allemagne); 2006 (1 month)
- Markus Lohrey; Univ. Leipzig (Allemagne); 2008 (1 month)
- Janos Makowsky; Technion (Israël); 2006 (2 months)
- Michael Moortgat; Université d’Utrecht (Pays-Bas); 2007 (2 months)
- Reinhard Muskens; Université de Tilburg (Pays-Bas); 2006-2007 (6 months)
- Pawel Parys; Warsaw University (Pologne); 2007-2008 (5 months)
- Helmut Seidl; TU Munich (Allemagne); 2008 (1 month)
- Howard Straubing; Boston (Etats-Unis); 2007 (1 month)

6.10.5 Invitations
- Michel Bauderon : Attaché pour la Science et la Technologie Consulat Général de France (Chine); 2005-2009 (4 years)
- Aymeric Vincent : Université de Varsovie (Pologne); 2007-2008 (1 year CRCT)
- Pascal Weil : Indian Institute of Science New Delhi (Inde); 2007-2009 (2 years)
- Marc Zeitoun : Université de Porto (Portugal); 2006-2008 (7 weeks)

6.11 Annexe D: Contracts and valorisation

6.11.1 Institutional contracts
- AVERISS; ANR SS; 2007-2009
- A3PAT; ANR Blanc; 2005-2008
- BINCOA; ANR LG; 2009-2012
- CAuLaD; ARC INRIA; 2009-2010
- Cryscoe; ANR SS; 2005-2008
- DOCFLOW; ANR Masses de Données; 2007-2010
- DOTS; ANR SS; 2007-2011
- GRAAL; ANR Blanc; 2007-2009
- ITIPY; Région Aquitaine; 2009-2012
- MORSE; RNTL; 2004-2006
- Mosaïque; ARC-INRIA; 2005-2007
- PRELUDE; ANR Blanc; 2007-2009
- RHAPSODIE, ANR; 2007-2011
- RIMEL; ANR SS; 2007-2009
- SPaCIFY; ANR LG; 2006-2009

6.11.2 Industrial contracts
- SOCIETE EADS; Evaluation de composants crytographiques dans la PMR; 2008-2010
- SOCIETE 2MORO; Fouille de données hétérogènes distribuées; 2009-2011
6.12 Annexe E: Thesis and HDR of the team

6.12.1 Habilitations

- Irène Durand (HdR, Université de Bordeaux I), "Call by need computations in orthogonal term rewriting systems", Juillet 2005
- David Janin (HdR, Université de Bordeaux I), "Contributions aux fondements des méthodes formelles : jeux, logique, et automates", Février 2005
- Renaud Marlet (HdR, Université de Bordeaux I), "Spécialiser les programmes, spécialiser les langages", Novembre 2007

6.12.2 Thesis

- Sévrine Fratani (directeur : Carrère, Senizergues), Automates à piles de piles ...de piles, Décembre 2005
- David Renault (directeurs : Narbel, Sénizergues), Étude des graphes planaires co-finis selon leurs groupes de symétries, septembre 2005
- Rodrigue Ossamy (directeurs : Mosbah, Métivier), An algorithmic and computational aspects to local computations, décembre 2005
- Roberto Bonato (directeur : Retoré), An Integrated Computational Approach to Binding Theory, juin 2006, co-tutelle Université de Verona
- Xavier Briand (directeurs Arnold, Walukiewicz), Sur la décidabilité de certains problèmes de synthèse de contrôleurs, juin 2006
- Julien Bernet (directeurs : Janin, Weil), Jeux discrets pour la synthèse et la validation de processus communicants, novembre 2006
- Brahim Hamid (directeurs : Mosbah, Métivier), Techniques de tolérances aux pannes pour les calculs locaux, juin 2007
- Maxime Amblard (directeur : Retoré), Calculs de représentations sémantique et syntaxe générative : les grammaires minimalistes catégorielles, septembre 2007
- Bilel Derbel (directeurs : Mosbah, Métivier), Aspects locaux dans les algorithmes distribués, décembre 2007
- Chen Rui (directeurs : Bauderon, Ly, Weil), Transformations et grammaires de graphes basées sur l’opération de pull-back, décembre 2007
- Shehla Abbas (directeurs : Mosbah, Zemmari), Calcul distribué à l’aide d’agents mobiles, décembre 2008
- Hedi Hamid (directeur : Mosbah), Modélisation de politique de sécurité dans les systèmes distribués, janvier 2009
- Shehla Abbas (Directeur : Mosbah, A. Zemmari), Calcul distribué par des agents mobiles, décembre 2009
- The Quang Tran (directeurs : Herbreteau, Sutre, Walukiewicz), Unfolding based verification of concurrent infinite state systems, juin 2009
6.12.3 Jointly advised thesis
- Houda Anoun directeurs : Leconte (Paris 8), Castéran, Approche logique des grammaires pour les langues naturelles, octobre 2007
- Mathias Samuelides (directeurs : Muscholl, Segoufin), Automates d’arbres à jetons, décembre 2007
- Florian Horn (directeurs : Muscholl, Thomas), Random games, novembre 2008
- Émilie Voisin (directeurs : Portine (Univ. Bordeaux 3), Marlet), Analyse syntaxique et formalisation d’énoncés en langue des signes française, novembre 2008
- Claire David (directeurs : Muscholl, Segoufin), Analyse de XML avec données non-bornées, mai 2009

6.13 Annexe F: Scientific responsibilities

6.13.1 Other
- Responsable master recherche (M. Zeitoun)
- Responsable de la Formation Doctorale (M. Mosbah)
- Responsable deuxième année (Master 1), filière Informatique, ENSEIRB (D. Janin)
- Responsable deuxième année (Master 1), filière RSI, ENSEIRB (D. Janin)
- Co-responsable des Lecons de Mathématiques d’aujourd’hui(G. Sénizergues)
- Responsable spécialité Algorithmes et méthodes formelles (C. Retoré)
- Responsable des stages de master (L. Clément)

6.14 Exposés invités

6.14.1 Conférences invitées
- International Conference on Semigroups and Languages, Lisbonne, juin 2005 (P. Weil)
- Zjazd Mathematykow Polskich 2005 Colloquium of Polish Mathematicians (Wroclaw, Poland, September 2005), I. Walukiewicz
- IFIP WG 2.2 Anniversary Meeting (Udine, Italy, September 2006), I. Walukiewicz
- AIML 2006 Advances in Modal Logic (Queensland, Australia, September 2006), I. Walukiewicz
- International Conference on Discrete Mathematics, Bangalore, India, Décembre 2006 (B. Courcelle)
- International Conference on Number Theory and Combinatorics, Srinivasa Ramanujan Centre, Kumbakonam, Inde, December 2006 (B. Courcelle)
- KNAW Academy Colloquium, New perspectives on Games and Interaction (Amsterdam, The Netherlands, February 2007), I. Walukiewicz
- Automata and Logic : History and Perspectives, Workshop on the occasion of Wolfgang Thomas’s 60th birthday (Aachen, Germany, December 2007), I. Walukiewicz
- Automata and Logic : History and Perspectives, Workshop on the occasion of Wolfgang Thomas’s 60th birthday (Aachen, Germany, December 2007), B. Courcelle
- First AutoMathA conference, Automata, from Mathematics to Applications, Mondello, juin 2007 (P. Weil)
- Computer Science in Russia, (Yekaterinburg, August 2007), G. Sénizergues
- Théorie des nombres et Combinatoire, Mahdia, Tunisie, Mai 2008 (Courcelle) ICALP, Reykjavik, Islande, Juillet 2008. (B. Courcelle)
- FoSSaCS 2008 Foundations of Software Science and Computation Structures (Budapest, Hungary, March 2008), I. Walukiewicz
APPENDIX – MF

CIE 2008, special session "Algorithmic Game Theory", (Athènes, Grèce, Juin 2008), H. Gimbert
AutoMathA 2009 Conference of the AutoMathA programme (Lieu, Belgique, Juin 2009), I. Walukiewicz
CAI 2009 : 3rd International Conference on Algebraic Informatics Thessalonique, Grèce, May 2009 (B. Courcelle)
EuroComb 2009, Bordeaux, Septembre 2009. (B. Courcelle)
International Conference on Geometric and Combinatorial Methods in Group Theory and Semigroup Theory, Lincoln, mai 2009 (P. Weil)

6.14.2 Workshops invitées

Perspectives in verification, workshop in honour of Prof. Dr. Wolfgang Thomas on the occasion of his doctorate Honoris Causa (Cachan, November 2005), I. Walukiewicz
Finite and Algorithmic Model Theory An Isaac Newton Institute Satellite Workshop (Durham, UK, January 2006), I. Walukiewicz
Workshop on tree automata, (Bonn June 7-9), 2006 A. Muscholl
Workshop on tree automata, (Bonn June 7-9, 2006), I. Walukiewicz
Workshop on Geometric and Asymptotic Group Theory and Applications, Manresa, septembre 2006 (P. Weil)
Theorientag Automaten und Formale Sprachen, (Leipzig, September 2007), G. Sénizergues
Symposium on group theory, (Luminy, Fevrier 2007), G. Sénizergues
Journées Formalisation des Activités Concurrentes (Toulouse, mars 2007) : Alain Griffault
Colloquium in Honour of Gérard Huet (Juin 2007), C. Retore
Modal Fixpoint Logics (Amsterdam, The Netherlands, March 2008), I. Walukiewicz
Journées Montoises d'Informatique Théorique 12èmes Journées Montoises d’Informatique Théorique (Mons, Belgium, August 2008), I. Walukiewicz
Workshop on Perspectives in Concurrency Theory on the occasion of P. S. Thiagarajan’s 60th birthday (Chennai, India, December 2008), I. Walukiewicz
Workshop on l’honneur de Hubert Comon, à l’occasion de sa réception de la médaille d’Argent du CNRS (Cachan, Novembre 2008), G. Sénizergues
Workshop Automata Theoretic Methods in Algorithmic Algebra, Bratislava, novembre 2008 (P. Weil)
Workshop on Automata and Verification, Mons (Belgique), août 2008 (F. Herbreteau et J. Leroux)
Workshop AutoMathA Developments and New Tracks in Trace Theory, (Cremona, Italy, October 2008), M. Zeitoun
Graph Minors Workshop, Banff International Research Station for Mathematical Innovation and Discovery (BIRS) (Septembre 2008), B. Courcelle
7th workshop on Lambda Calculus and Formal Grammars (Bordeaux, Mars 2009), G. Sénizergues
Journée «Théorie des Jeux et Informatique», 2009 (Paris, February 2009), H. Gimbert
Workshop on Equational theory of regular languages (Brno, March 6-7 2009), M. Zeitoun
DIMAP workshop on Algorithmic Graph Theory, (Warwick, G.B., Mars 2009), B. Courcelle
Workshop on Geometric and Asymptotic Group Theory and Applications, (Hoboken, mars 2009), P. Weil
6.14.3 Ecoles

- EPIT 2006 34e Ecole de Printemps en Informatique Theorique "Jeux : entre sémantique et vérification" (Ile de Ré, May 2006) I. Walukiewicz
- MOVEP 2006 MOdelling and VErifying parallel Processes (Bordeaux, June 2006) I. Walukiewicz
- Ecole jeunes chercheurs en Calcul Formel Méthodes logiques pour la syntaxe et la sémantique du langage naturel Bordeaux, 2006 Retoré
- ESSLLI 2006 Ecole Européene en Logique, Linguistique et Informatique, Retoré
- Fall School on Algorithmic Graph Structure Theory. Tutorial, Berlin, October 2007 B. Courcelle
- Summer School on Verification Technology, Systems & Applications, (Saarbrücken, Allemagne, Septembre 2008), G. Sutre
- School on Algebraic Topics of Automata (Lisbonne, Septembre 2008), G. Sénizergues
- EALING Fall School in Linguistics, (ENS Paris 2008), C. Retoré
- ESSLLI 2009 21e Ecole Européene en Logique, Linguistique et Informatique (Bordeaux, Juillet 2009) B. Courcelle
- ESSLLI 2009 21e Ecole Européene en Logique, Linguistique et Informatique (Bordeaux, Juillet 2009) S. Salvati
- First Asian Pacific Summer School on Formal Methods (Aug 2009, Beijing) P. Castéran

6.15 Masters et stages encadrés

- Jules Vanier, ECP/Paris 6, 2005 (Marlet, Retoré)
- Cyril Cohen, ENS Cachan, 2 mois, 2006 (Retoré)
- Florent Martin, ENS Cachan, 3 mois, 2006 (Sénizergues)
- Eudes Petonnet, ENS Cachan 1ère année, été 2006 (Leroux, Sutre)
- Shrivathsan, IIT Bombay, 3 mois, 2007 (Herbreteau, Walukiewicz)
- Aaditya Ramdas, IIT Bombay, 3 mois, 2007 (Fleury, Zeitoun)
- Emanuel Lassalle, ENS Lyon 1ère année, 5 semaines, été 2007 (Janin)
- Clément Toromanoff, ENS Cachan 1ère année, 2007 (Zeitoun, Leroux)
- Richie Abraham, IIT Bombay, 3 mois, 2008 (Walukiewicz)
- Arthur Ball, ENSIMAG, 3 mois, 2008 (Retoré, Salvati)
- Clément Toromanoff, ENS Cachan 1ère année, 6 semaines, 2008 (Leroux, Zeitoun)
- Philippe Ramnou, ENS Ker-Lann 1ère année, 5 semaines, printemps 2008 (Gimbert)
- Julien Ferté, ENS Cachan 2009 (Sénizergues)
- Antoine Delignat-Lavaud, ENS Cachan 1ère année, 6 semaines, 2009 (Muscholl, Zeitoun).
- Diego Llarrull, Universidad National de Rosario (Argentine), 4 mois, 2009 (Marlet).
- Paul Brunet ENS Cachan 1ère année, 2009 (Clément Retoré)
Team

Supports and Algorithms for High Performance Numerical Applications (SATANAS)

Head: R. NAMYST

Activities:

• Team-Project ScAlApplix
  Head: J. ROMAN
  Keywords: High Performance Computing, Numerical Simulation, Complex Applications, Parallel Algorithms

• Team-Project Runtime
  Head: R. NAMYST
  Keywords: Runtime System, High Performance Computing, Cluster, Grid, Operating System
7.1 Members
(at 31st of August 2009)

E₁: Team-Project ScAlApplix
E₂: Team-Project Runtime

7.1.1 Permanent faculty

<table>
<thead>
<tr>
<th>Name</th>
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<td>Dir. adjoint UFR</td>
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Total ETPC²: 12 (PR: 3 DR: 1 MCF: 9 CR: 4 IGR: 1)

¹ Restricted to (vice-)presidents and (deputy-)directors of school, laboratory, department, and of international relationships.
² Equivalent Temps Plein Chercheur.
7.1.2 Temporary personnel

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<td>Gaidamour, J.</td>
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<td>Moreaud, S.</td>
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Total\(^1\) ETPC: 9

7.1.3 Personnel under industrial contract

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<td>Doct 2006-</td>
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Total\(^1\) ETPC: 1.7

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1. *Prorata temporis.*
7.2 Research summary

The SATANAS team is composed of the two INRIA Project-Teams RUNTIME and ScAlApplix. Both teams belong to the INRIA Bordeaux – Sud-Ouest, The University of Bordeaux (PRES), the CNRS (through the LaBRI, UMR 5800 for both and also the IMB UMR 5251 for ScAlApplix). The Project-Teams focus in a complementary way on the development and deployment of real world scientific applications in the field of high-performance and intensive computing.

Deploying complex scientific applications that need large amounts of computing and communication capabilities on large scale parallel and distributed platforms is a major challenge in the current computer science landscape. It is also a strategic topic strongly supported by the Ministry of Research, the ANR through its reiterated calls for proposals (CIGC, CIS, COSINUS), the CNRS through its Grids Institute, the INRIA that included in its 2008-2012 Strategic Plan a topic labelled “Modeling, simulating and optimizing complex dynamic systems”, the EU and the USA through PRACE and IESP projects in order to dispose of a petaflopic computing power in 2011 and an hexaflopic on the horizon 2014.

7.2.1 High-performance runtime systems (RUNTIME)

Runtime is an INRIA Project-Team since 2004 whose research activities are focused on the design and implementation of efficient runtime systems tailored for a large spectrum of hardware such as clusters or grids. Since such parallel hardware undergoes tremendous architectural changes, it is crucial to use tools that are able to fully exploit such architectures. Indeed these machines are complex, following a trend where the number of levels is multiplied for both computing units (nodes, cores, threads, GPUs) and memory (various cache levels, NUMA effects). As a consequence, such machines naturally become hierarchical and heterogeneous. The goals of Runtime’s research activities are various : on one hand to ensure portability of applications performance on a wide spectrum of architectures and on the other hand to facilitate parallel applications development. In particular, natural opportunities to apply Runtime’s works can be found with current standards for parallel programming, such as MPI or OpenMP. Implementations of those standards that use the tools developed by the Runtime group benefit from substantial performance improvements. Since 2005, the Runtime group is active on two main topics : clusters and grids communication and efficient support for multithreading.

Communication support for clusters and grids

Runtime’s experience with regard to high-performance communication is extensive and has lead to the creation of the NewMadeleine communication library. This communication library is able to exploit in a generic fashion a wide range of high-performance networks. NewMadeleine works differently from other regular communication libraries since communication is steered by NICs activity in order to uncouple network activity from the application’s. This scheme allows to apply on-the-fly optimizations to the stream of packets, such as packet aggregation, packet reordering or splitting packets in several chunks sent through different NICs. The presence of several NICs in recent clusters reduces one traditional bottleneck, that is, network communication. Since the NewMadeleine network drivers and the available optimization strategies are fully generic, it is thus possible to exploit optimally several networks simultaneously.

The development of multicore processors and thus the increase of the amount of computing entities in clusters leads to the use of threads by the applications. NewMadeleine fully supports concurrent accesses and takes advantage of it to expand the scope of its optimizations. In order to efficiently exploit current hardware, NewMadeleine uses PIOMan as a progress engine. PIOMan is an event manager working tightly with the Marcel thread scheduler. NewMadeleine delegates the management of network events to PIOMan which makes communication progress in the background transparently. PIOMan also gives NewMadeleine the possibility to offload some costly work on unused computing units.
The numerous research works of Runtime dealing with communication have also influenced the design of implementations of higher-level programming standards, such as MPI (Message Passing Interface). If such research effort in implementations started a long time ago, it is worth noting that the Runtime group is involved since 2005 in the design and development of MPICH2, one the main free MPI-2 implementations. In particular, we have developed a new communication subsystem called Nemesis, which is now a central component of MPICH2’s software stack. Nemesis’ goal is to yield the best performance for communication using shared-memory. This piece of software is therefore complementary to NewMadeleine since the latter only addresses network communication. Nemesis acts as a runtime system for MPICH2 (since release 1.1) and should be used by Microsoft and Intel in their own MPI software.

Runtime also worked on an integration that goes beyond clusters and MPI to reach grids and code coupling applications through CORBA. Such integration is made possible thanks to the PadicoTM communication platform, built with software components that allow the user to assemble its own communication stack (eg. network driver, data processing, middleware) in order to fit his needs. The PadicoTM platform is in particular by the Project-Team ScAlApplix in its EPSN software in order to allow CORBA communication to use high-speed networks. It is also used by the Project-Team GRAAL in its DIET platform to ensure a CORBA connectivity in non-routed firewalled networks.

The expected convergence between high-speed network technologies tailored for high-performance computing and traditional Ethernet technologies raises the question of how enabling efficient communication in parallel applications without dedicated advanced hardware. Runtime addressed this issue by developing the Open-MX software in collaboration with the Myricom enterprise. This work makes possible to improve communication performance in parallel applications without the requirement of advanced hardware support in the NICs. It has been nevertheless shown that simple changes in traditional networking technologies could induce a performance increase at a small cost. The Open-MX software can be transparently integrated into an existing MPI implementation while adapting itself to the lesser capabilities of the underlying network hardware. The work carried out in the Open-MX software have emphasized the lack of performance for very large message transfers using shared memory in MPI libraries. This has lead us to develop the KNEM kernel module in the framework of an INRIA Associate-Team program with Argonne National Laboratory (the MPICH2 original creator/developer). KNEM is dedicated to improve the performance of large intra-node messages in MPICH2. KNEM is assisted by the operating system and is able to offload memory copies onto dedicated hardware. By taking into account recent architectures’ characteristics, and more specifically cache sharing, it thus becomes possible to dynamically choose the best fitting transfer strategy. This work improves significantly performance in multicore nodes, in particular when numerous processes communicate simultaneously (collective communication operations).

Runtime also showed that the complex hardware characteristics of modern architectures have a great influence on the performance of communication using the network. Indeed, the physical distances between CPUs, memory banks and I/O devices become heterogeneous. It is therefore mandatory to take such constraints into account when placing communication tasks.

All the aforementioned convergences between our group and the Radix Lab at Argonne National Laboratory (Chicago, USA) which develops the MPICH2 software have spurred the creation of an INRIA Associate Team. This team is active since 2008 and has strengthened the existing exchanges. The outcome of this collaboration is materialized by several publications and several software productions: integration of NewMadeleine in MPICH2 as a Nemesis network module, kernel-assisted version of Nemesis (KNEM), new support for high-speed networks in MPICH2, etc.

The relationships between Runtime and the Ishikawa Laboratory (Tokyo, Japan) which created and develops YAMPI and GridMPI (two other free MPI implementations) have motivated a Sakura partnership since 2009. The goal of this collaboration is to design and implement a generic platform able to optimize communication as well as distant I/O. The ongoing work aims at integrating NewMadeleine and PIOMan into this platform, but also into YAMPI3.
Multithreading

The efficiency of the execution of an irregular parallel application on hierarchical machines relies on the quality of the task scheduling and the data placement in order to avoid as much as possible NUMA effect penalties, contention on the memory bus, and cache misses. The current operating systems are helpless because too generic and leave the application developers on their own. Thus, the developers have to explicitly adapt each application to the underlying hardware.

In order to ensure performance portability, we have defined the concept of bubble of threads that expresses the parallelism’s structured nature and we modelize the target machine’s architecture with a hierarchical list of tasks. A bubble is a recursive structure that encompasses bubbles, threads or even thread seeds (lazily created). A programming interface and high-level debugging tools make it possible to easily develop dedicated schedulers that are both efficient and portable.

It is therefore a genuine platform to develop and experiment with bubble schedulers that has been integrated into the Marcel user-level thread library. The OpenMP support in the gcc compiler (GOMP) has been expanded in order to make use of this library and express with bubbles the structured nature of nested parallel sections. Thanks to the POSIX compatibility layer available in Marcel, these supports have allowed us to test several bubble schedulers on various applications. For instance, in the case of the structured execution of OpenMP programs, we have developed three schedulers: one scheduler that enforces load balancing, a second that is cache-oriented and the last one that is memory-oriented. By combining the last two, we obtain a scheduler tailored for NUMA architectures. The performance improvements gained on applications such as BT-MZ or CG (NAS parallel benchmarks) or MPU (3D images reconstruction) are around 20% and advocate for our approach.

These research works dealing with scheduling but also communication rely on a sharp knowledge of the underlying architecture. We have regrouped in the libtopology library the portable and abstract management of various hierarchies: cores, caches, nodes, memory, etc. This thorough knowledge allows to place in a generic way threads, processes, memory zones or MPI communications according to the hardware characteristics, thus yielding substantial performance improvements for MPI and/or OpenMP applications.

The recent interest for the offloading of computing kernels on accelerators or graphical processors (GPGPU, Cell/BE) brought a new dimension of heterogeneity into the scheduling issue. We have designed the StarPU platform that makes possible to define scheduling algorithms that makes the decision during the execution to offload (or not) computing kernels, based on the efficiency of the kernels’ implementation for a core or a given accelerator. Such efficiency is determined during the execution by regression-based performance models. The performance obtained are therefore better than a static placement and even superlinear thanks to the affinities between the nature of the tasks and the type of computing resources. The data availability on the accelerators is also optimized transparently to the application programmer with a software DSM algorithm and can be taken into account for the scheduling.

7.2.2 High Performance Schemes and Algorithms for Complex Scientific Applications (ScAlApplix)

The purpose of the ScAlApplix project is to analyze and to solve scientific computation problems arising from complex research and industrial applications and involving scaling. These applications are characterized by the fact that they require enormous computing power, on the order of tens or hundreds of teraflops, and that they handle huge amounts of data. Solving these kinds of problems requires a multidisciplinary approach concerning both applied mathematics and computer science. In applied mathematics, it is essentially the field of numerical schemes that is concerned. In computer science, parallel computing and the design of high-performance codes to be executed on today’s major computing platforms are concerned. Our research leads to an important technological transfer in the framework of strong collaborations with industrial partners using simulation and high performance computing.
In this activity report, we will focus on the specific research works related to LaBRI topics. ScalApplix INRIA project team (http://www.labri.fr/projet/scalapplix/scalapplix.html) has been created on the first of November 2002 and has been stopped at the end of 2008 in order to create two new project teams Bacchus and HiePACS which are currently evaluated by INRIA.

**Algorithms and tools for high performance computing**

**Complex data partitioning and linear algebra solvers**

**Graph partitioning** Several large works have been undertaken in order to parallelize the sequential partitioning tools which had been developed until then. First, during the PhD thesis of Cédric Chevalier (2004-2007), parallel algorithms for coarsening, folding and vertex partitioning of distributed graphs were devised. Their implementation within version 5.0 of Scotch allowed us to provide an efficient tool for parallel sparse matrix reordering. These works were continued during the post-doc of Jun-Ho Her (2007-2009), which led to the implementation, in version 5.1 of Scotch, of an efficient parallel method for partitioning distributed graphs. Meanwhile, the PhD of Sébastien Fourestier (2008-) started with a preliminary work on the evaluation of the interest of static mapping for NUMA architectures, before turning towards parallel dynamic graph repartitioning.

**Direct solvers for large sparse linear systems** A large amount of work has been done to be able to process larger and larger problems and to efficiently exploit modern architectures. The concerned methods are the so-called direct methods. They are characterized by their large memory needs. We have proposed static and dynamic algorithms to minimize the memory requirements in both sequential and parallel contexts. These approaches have been studied within the context of two sparse direct solvers: MUMPS and PaStiX. In addition, with the objective of treating even larger problems, we focussed on out-of-core techniques where disks are used to unload the memory. Finally, to deal with modern multicore and NUMA architectures, we were interested to scheduling and data management issues. It is important to note that in the context of these activities three PhD thesis were done at LaBRI, CERFACS and LIP.

**Iterative and hybrid direct/iterative methods** The goal of our works was to design some sparse linear solvers able to scale in term of memory and CPU time. We have developed new iterative and hybrid direct/iterative algorithms. In particular, we have focused our works on incomplete factorizations because they allow to build generic preconditioners for iterative methods. Thus, we have developed an amalgamation algorithm in order to use a block incomplete factorization based on the level of fill ($ILU(k)$). This work has been implemented in PaStiX and they allow to significantly decrease the CPU time compared to the scalar $ILU(k)$ algorithms. We have also developed some efficient algorithms for $ILUT$ factorizations (that are based on a numerical criterion to drop small entries in the factors). In this framework, we have developed a parallel multi-level ILUT factorization based on the use of the Schur complement and a special ordering of the unknowns. We have used this multilevel method to design a hybrid direct-iterative solver: this is a special case where the first level is treated by a direct factorization. The goal of such an hybrid solver is to combine the robustess of direct methods and the low consumption in memory and CPU time of iterative methods. The works on multilevel ILUT and hybrid solvers has been implemented in the HIPS software.

Our works on sparse linear solvers are supported by the ANR project CIGC 2005 NUMASIS and CIS 2006 SOLSTICE (http://solstice.gforge.inria.fr/) and also in the associated team Phy-LeaS (http://www-sop.inria.fr/nachos/phyleas/) joint with the University of Minneapolis and the University of Brunswick.
Fast multipole methods and interaction computations The Fast Multipole Method (FMM) is a hierarchical method which computes interactions for the N-body problem in $O(N)$ time for any given precision. In order to compute energy and forces on large systems, we need to improve the computation speed of the method. This has been realized thanks to a matrix formulation of the main operator in the far field computation: this matrix formulation is indeed implemented with BLAS routines (Basic Linear Algebra Subprograms). Even if it is straightforward to use level 2 BLAS (corresponding to matrix-vector operations), the use of level 3 BLAS (that corresponds to matrix-matrix operations) is interesting because much more efficient. So, thanks to a careful data memory storage, we have rewritten the algorithm in order to use level 3 BLAS, thus greatly improving the overall runtime. Our BLAS version has then been extended to non uniform distributions, requiring therefore a new octree data structure named octree with indirection, that is efficient for both uniform and non uniform distributions. We have also designed an efficient algorithm that detects uniform areas in structured non uniform distributions, since these areas are more suitable for BLAS computations. An efficient parallel code of our BLAS version, based on an hybrid MPI-thread programming, has finally been developed and validated on shared and distributed memory architectures.

Computational steering The computational steering is an effort to make the typical simulation work-flow (modeling, computing, analyzing) more efficient, by providing online visualization and interactive steering over the on-going computational processes. The online visualization appears very useful to monitor and to detect possible errors in long-running applications, and the interactive steering allows the researcher to alter simulation parameters on-the-fly and to immediately receive feedback on their effects. Thus, the scientist gains an additional insight in the simulation regarding to the cause-and-effect relationship. In the ScAlApplix project, we have studied this problem in the case where both the simulation and the visualization can be parallel, what we call M-by-N computational steering, and we have developed a software environment called EPSN (Environment for the Steering of Parallel Numerical Simulations). In other words, we want to provide an environment that can benefit from immersive virtual reality technology (e.g. tiled display wall) and that might help scientists to better grasp the complexity of real-life simulations. Such a coupling between parallel numerical simulations and parallel visualization systems raises two crucial issues we have studied: the problem of parallel coordination of steering operations and the problem of data redistribution of complex objects such as structured grids, particle set and unstructured meshes. All these works have been validated with legacy simulations that come from several different scientific fields, such as material physics, astrophysics, molecular dynamics or fluid flow mechanics. More recently, we have proposed a model for the steering of complex coupled simulations, like multiphysics or multiscale simulations. These works have been mainly realized during two PhD thesis at LaBRI and INRIA and have been supported by several ANR projects. The EPSN software is freely available at INRIA Gforge.

Complex scientific applications

Multiscale schemes for material physics Due to the increase of available computer power, new applications such as failure material simulations like crack propagation are now commonly performed by physicists. These computations simulate systems up to billion of atoms in materials and for large time scales up to several nanoseconds. The larger the simulation is, the smaller the computational cost of the potential driving the phenomena is, resulting in low precision results. Moreover, full simulations at the finest level are not computationally feasible on the whole materials. Most of the time, the finest level is only necessary where the phenomena of interest occurs, for example in a crack propagation simulation far from the tip, we have a macroscopic behavior of the material and then we can use a coarser model. The idea is to limit the more expensive level simulation to a subset of the domain and to combine it with a macroscopic level. But combining quantum and atomistic or atomistic and continuum simulations are still a challenge to obtain a robust model, a good scheme and an efficient implementation. Thanks to collaboration with the CEA Ile-de-France, we have developed a new research activity on multiscale methods: Firstly in
the study of crack propagation in silica glasses and secondly, in the coupling of a quantum model with a molecular model. We are focused on several aspects of these problems: 1) a more robust numerical coupling to avoid waves reflections 2) parallelism improvements in the coupling to treat large 3D simulations.

Magnetohydrodynamics We have established a collaboration with the physicists of the CEA/DRFC group in the context of the ANR CIS 2006 project called ASTER. The MagnetohydroDynamic instability called ELM for Edge Localized Mode is commonly observed in the standard tokamak operating scenario. The energy losses the ELM will induce in ITER plasmas are a real concern. However, the current understanding of what sets the size of these ELM induced energy losses is extremely limited. Recently, encouraging results on the simulation of an ELM cycle have been obtained with the JOREK code that uses a fully implicit time evolution scheme in conjunction with the PASTiX solver.

Domain decomposition to solve neutron transport equations A collaboration started with EDF/SINETICS team to design and develop techniques to optimize the efficiency of the codes used to simulate the physics of nuclear reactors. Bruno Lathuilère started in 2006 a thesis on domain decomposition methods applied for solving neutron transport equations. A non-overlapping domain decomposition method has been proposed for the approximate resolution of the linear system to solve at each inverse power iteration (required to compute the highest eigenvalue of a generalized eigenvalue problem). This method allows us to adapt locally the numerical resolution (mesh, finite element order).

7.3 Visibility

<table>
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7.4 Jurys

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<td>Thesis (but LaBRI)</td>
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<tr>
<td>Competitive examination</td>
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<tr>
<td>Award committee</td>
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7.5 Collaborations, contracts and valorization

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For world map, see Figure 1.2.

7.6 Thesis and HDR

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7.7 Publications of the team SATANAS

7.7.1 Summary

<table>
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Be reminded that all the publications listed here under the category Journals and the vast majority of those listed under the category Conferences and Books (and many of those listed under the category Other) are publications of Rank A as defined by the AERES. Indeed, it is the team that has chosen the journals and the conferences that are highlighted with the label Selection in order to put emphasis on certain publication media, and in no case does this imply the declaration of the complement of this selection as being of lower quality.

7.7.2 Journals [ACL]

(journals with editorial board registered by AERES or by international data bases)

Selection


Other


7.7.3 Conferences [INV, ACTI, ACTN]
(invited conferences, international or national conferences with proceedings)

Selection


BIBLIOGRAPHY – SATANAS


Invited
(invited speaker in international or national conferences)


Other


[Ca3] C. Augonnet, S. Thibault, R. Namyst, and M. Nuijens, Exploiting the cell/be architecture with the starpu unified runtime system, in SAMOS Workshop, S. Verlag, ed., 2009.


BIBLIOGRAPHY – SATANAS


7.7.4 Books [OS, OV]

(scientific book or chapter)


7.7.5 Other publications [ACLN, ASCL, COM, AFF, DO, AP]

(reviews without review process, oral contribution without proceedings, poster, editorial board, registered software, translations, guides and technical reports, intermediate reports for large project)


7.8 Annexe A: Visibility

7.8.1 Editorial board, invited editor

- Co-éditeur du numéro spécial de la revue "Parallel Computing" pour "PMAA" 2006 (J. Roman)

7.8.2 Program committee

- Chair du Workshop "EXPGRID" (Experimental Grid testbeds for the assessment of large-scale distributed applications and tools) en 2006 et 2007 (R. Namyst)
- "VECPAR" (2006 et 2008) (O. Coulaud)
- "HeteroPar" (depuis 2007) (A. Guermouche)
- "International Workshop on Parallel Programming Models and Systems Software for High-End Computing" (depuis 2009) (G. Mercier)
- "Workshop on High Performance Interconnects for Distributed Computing" (depuis 2009) (G. Mercier)
- "HPIDC" (depuis 2009) (G. Mercier)
- "P2S2" (depuis 2009) (G. Mercier)
- "EUROPVM/MPI" (depuis 2006) (R. Namyst)
- "CLUSTER" (depuis 2006) (R. Namyst)
- "CCGRID" (depuis 2006) (R. Namyst)
- "HPCVirt" (depuis 2008) (R. Namyst)
- "HPGC" (de 2005 à 2008) (F. Pellegrini)
- "PMAA" (depuis 2006) (J. Roman)
- "ADVCOMP IEEE" (depuis 2007) (J. Roman)
- "CSC SIAM" (2007) (J. Roman)
- "PPAM" (2007) (J. Roman)
- "Preconditionning SIAM" (2007) (J. Roman)
- "EuroMicroPDP IEEE" (depuis 2008) (J. Roman)
- "PARCO" (2009) (J. Roman)
- "HPCVirt" (depuis 2009) (S. Thibault)
- "Conférence Française en Systèmes d’Exploitation" (depuis 2009) (A. Denis)
- "Rencontres francophones du Parallélisme" (depuis 2009) (A. Denis)
- "Rencontres francophones du Parallélisme" (depuis 2005) (R. Namyst)
- "Rencontres francophones du Parallélisme" (depuis 2005) (J. Roman)

7.8.3 Conference organization

- Co-organisateur de l’école CEA-EDF-INRIA du 6 au 9 novembre 2006, "Calcul scientifique intensif : algorithmes, outils logiciels et applications" (J. Roman)
- Co-organisateur de l’école CEA-EDF-INRIA du 30 mars au 3 avril 2009, "Méthodes robustes et algorithmes pour le traitement de grands systèmes algébriques sur architectures de calcul haute performance modernes" (J. Roman)

7.8.4 Evaluation

- Membre nommé de la Commission Nationale d’Évaluation de l’INRIA (depuis 2005) (J. Roman)
– Membre du comité de pilotage du programme CIS Calcul Intensif et Simulation (2005-2007) (J. Roman)
– Membre du comité scientifique de l’ANR Cosinus (2009) (J. Roman)

7.9 Annexe B: Jurys

7.9.1 Habilitations (but LaBRI)
– Membre d’1 jury d’habilitation en 2006 (R. Namyst)
– Membre de 2 jurys d’habilitation en 2006 et 2009 (J. Roman)

7.9.2 Thesis (but LaBRI)
– Membre et rapporteur de 2 jurys de thèse en 2007 (O. Coulaud)
– Membre de 2 jurys de thèse pour 2007-2008 (O. Coulaud)
– Membre d’un jury de thèse en 2009 (A. Guermouche)
– Membre et rapporteur de 8 jurys de thèse pour 2005-2009 (R. Namyst)
– Membre de 8 jurys de thèse pour 2005-2009 (R. Namyst)
– Membre d’un jury de thèse en 2007 (F. Pellegrini)
– Membre et rapporteur d’un jury de thèse en 2008 (J.Roman)
– Membre de 9 jurys de thèse pour 2005-2008 (J. Roman)

7.9.3 Concours
– Membre de 2 comités de sélection (1 Prof, 1 MdC) à l’ENSEEIHT en 2009 (R. Namyst)
– Membre de 5 jurys de concours CR2 ou CR1 et de 5 jurys de concours DR2 à l’INRIA depuis 2005 (J. Roman)

7.10 Annexe C: Collaborations

7.10.1 Conventions or international cooperations
– Equipe Associée INRIA MPI-RunTime avec Argonne National Laboratory (USA) depuis 2008
– Equipe Associée INRIA PHyLeaS entre ScAlApplix, les Universités du Minnesota (USA) et de Brunswick (Allemagne), l’INRIA Sophia-Antipolis Méditerranée et l’IRIT de 2008 à 2010
– Projet France-Berkeley avec le CERFACS, l’IRIT et l’INRIA Rhône-Alpes de 2008 à 2010
– Projet Franco-Israelien P2R avec l’Université de Tel-Aviv de 2009 à 2011
– Projet Franco-Japonais avec le JAEA de 2007 à 2009
– Projet Franco-Japonais NEGST de 2006 à 2009
– Projet Pessoa avec l’Université d’Evora (Portugal, Salvador Abreu) de 2008 à 2009
– Projet Sakura avec l’Université de Tokyo (Japon, Yutaka Ishikawa) de 2009 à 2010

7.10.2 Others
– Sandia - Albuquerque (USA) de 2007 à 2009

7.10.3 Guests
– Salvador Abreu; Université d’Evora; 2009 (1 week)
– Tomoya Adachi; Université de Tokyo; 2009 (1 week)
– Matthias Bollhoefer; TU Brunswick (Allemagne); 2008 (1 week)
– Darius Buntinas; Argonne National Laboratory (Etats-Unis); 2008 (1 week)
– Dave Goodell; Argonne National Laboratory (États-Unis); 2008 (2 weeks)
– Akihiro Nomura; Université de Tokyo; 2009 (1 week)
7.10.4 Invitations

- Cédric Augonnet : Université d’Evora (Portugal) ; 2008 (1 week)
- Olivier Aumage : Université d’Evora (Portugal) ; 2008 (1 week)
- Olivier Aumage : Université d’Ioannina (Grèce) ; 2008 (1 week)
- François Broquedis : Université d’Ioannina (Grèce) ; 2008 (1 week)
- Elisabeth Brunet : Argonne National Laboratory (Etats-Unis) ; 2007 (2 weeks), 2008 (1 week)
- Jérôme Clet-Ortega : Argonne National Laboratory (Etats-Unis) ; 2008 (2 weeks)
- Jérôme Clet-Ortega : Université de Tokyo (Japon) ; 2008 (1 week)
- Jérôme Clet-Ortega : Université d’Evora (Portugal) ; 2008 (1 week)
- Olivier Coulaud : Université de Minneapolis (Etats-Unis) ; 2008 (10 days)
- Alexandre Denis : Université de Tokyo (Japon) ; 2007 (1 week), 2009 (1 week)
- Alexandre Denis : Université de Kyoto (Japon) ; 2009 (1 week)
- Jérémie Gaidamour : Université de Minneapolis (Etats-Unis) ; 2007 (10 days), 2008 (2 months)
- Brice Goglin : Argonne National Laboratory (Etats-Unis) ; 2008 (1 week)
- Brice Goglin : Myricom (USA) ; 2008 (1 week)
- Pascal Hénon : Université de Minneapolis (Etats-Unis) ; 2007 (10 days), 2008 (20 days)
- Guillaume Mercier : Argonne National Laboratory (Etats-Unis) ; Post-doc 2005-2006 (18 months), 2007 (2 weeks), 2008 (2 weeks), 2009 (2 weeks)
- Guillaume Mercier : Université de Tokyo (Japon) ; 2007 (2 weeks)
- Stéphanie Moreaud : Argonne National Laboratory (Etats-Unis) ; 2008 (1 week)
- Raymond Namyst : Université de Tokyo (Japon) ; 2008 (2 months)
- François Pellegrini : Sandia albuquerque (Etats-Unis) ; 2007 (1 week)
- Pierre Ramet : Université de Minneapolis (Etats-Unis) ; 2008 (10 days)
- Jean Roman : Université de Minneapolis (Etats-Unis) ; 2005 (10 days), 2006 (10 days), 2007 (10 days), 2008 (10 days)
- François Trahay : Argonne National Laboratory (Etats-Unis) ; 2008 (3 weeks), 2009 (2 weeks)
- François Trahay : Université de Tokyo (Japon) ; 2009 (2 weeks)
- Pierre-André Wacrenier : Université d’Ioannina (Grèce) ; 2008 (1 week)

7.11 Annexe D: Contracts and valorisation

7.11.1 Institutional contracts

- EPSN ; ACI GRID ; 2002-2005
- GRID5000 ; ACI GRID ; 2005-2006
- TLSE ; ACI GRID ; 2002-2005
- ACI Masse de Données ; 2005-2006
- SIRE ; ACI IMPBIO ; 2004-2006
- ASTER ; ANR CIS ; 2007-2009
- HALOBAR ; ANR Blanc ; 2006-2010
- LEGO ; ANR CIGC ; 2006-2009
- MASSIM ; ANR Masse de Données ; 2005-2008
- NOSSI ; ANR CIS ; 2007-2010
- NUMASIS ; ANR CIGC ; 2006-2009
- PARA ; ANR CIGC ; 2005-2007
- PETAL ; ANR COSINUS ; 2009-2011
- ProHMPT ; ANR COSINUS ; 2008-2010
- SOLSTICE ; ANR COSINUS ; 2007-2009
- COA ; ARC-INRIA ; 2005-2006
- PLASMA ; ARC-INRIA ; 2005-2007
7.11.2 Industrial contracts
- CEA-CESTA; 2005-2008
- CEA Ile-de-France; 2005
- EDF; 2006-2009
- Myricom; 2007-2009
- TOTAL; 2008-2010

7.11.3 Software pre-patented
- Open-MX (http://open-mx.org) : APP IDDN.FR.001.290034.000.S.P.2008.000.31235 : Passage de messages haute performance sur technologies Ethernet génériques
- PadicoTM (http://runtime.bordeaux.inria.fr/PadicoTM/) : APP IDDN.FR.001.260013.000.S.P.2002.000.10000 : Plateforme de communication haute-performance pour grilles

7.11.4 Other software
- EPSN (http://www.labri.fr/projet/epsn/) : Environnement pour le Pilotage de Simulations Numériques
- FMB : Code parallèle multipôles pour l’astrophysique et la dynamique moléculaire
- ForestGomp (http://runtime.bordeaux.inria.fr/forestgomp/) : Plateforme OpenMP pour architectures hiérarchiques
- HIPs (http://hips.gforge.inria.fr) : Méthodes de résolution parallèles itératives et hybrides directes/itératives pour les systèmes linéaires creux
- LibMultiscale (http://libmultiscale.gforge.inria.fr/) : Bibliothèque parallèle pour le couplage de méthodes multiéchelles en physique des matériaux
- Marcel (http://runtime.bordeaux.inria.fr/marcel/) : Bibliothèque multithreads pour calcul haute performance
- MPICH2-Nemesis (http://www.mcs.anl.gov/research/projects/mpich2/) : Implémentation portable et haute performance de MPI
- MUMPS (http://mumps.enseeiht.fr/) : Solveur multifrontal parallèle pour la résolution de systèmes linéaires creux
- NewMadeleine (http://runtime.bordeaux.inria.fr/newmadeleine/) : Moteur d’optimisation dynamique des communications pour réseau haute performance
- PIOMan (http://runtime.bordeaux.inria.fr/pioman/) : Gestionnaire d’entrées/sorties unifié
- Scotch (http://scotch.gforge.inria.fr) : Bibliothèques séquentielles et parallèles pour le partitionnement de graphes, le placement statique et la renumérotation de matrices creuses
- StarPU (http://runtime.bordeaux.inria.fr/StarPU/) : Support exécutif unifié pour architectures multicoeur hétérogènes

7.12 Annexe E: Thesis and HDR of the team

7.12.1 Thesis
- Guillaume Anciaux (dir. Olivier Coulaud et Jean Roman) : "Simulation multi-échelles des solides par une approche couplée dynamique moléculaire / éléments finis. De la modélisation à la simulation haute performances", Juillet 2007, LaBRI
– Cédric Chevalier (dir. François Pellegrini) : "Conception et mise en oeuvre d’outils efficaces pour le partitionnement et la distribution parallèles de problèmes numériques de très grande taille", Septembre 2007, LaBRI
– Aurélien Esnard (dir. Olivier Coulaud et Jean Roman) : "Analyse, conception et réalisation d’un environnement pour le pilotage et la visualisation en ligne de simulations numériques parallèles", Décembre 2005, LaBRI
– Marc Pérache (dir Raymond Namyst) : "Contribution à l’élaboration d’environnements de programmation dédiés au calcul scientifique hautes performances", Octobre 2006, LaBRI
– Samuel Thibault (dir. Raymond Namyst) : "Ordonnancement de processus légers sur architectures multiprocesseurs hiérarchiques : BubbleSched, une approche exploitant la structure du parallélisme des applications", Décembre 2007, LaBRI

7.13 Annexe F: Scientific responsibilities

7.13.1 Other
– Membre du COST GTAI à l’INRIA depuis 2007 (O. Coulaud)
– Intervenant à l’école CEA-EDF-INRIA du 6 au 9 novembre 2006, "Calcul scientifique intensif : algorithmes, outils logiciels et applications" (P. Henon)
– Conseiller Scientifique auprès du CEA/DAM depuis 2008 (R. Namyst)
– Intervenant à l’école d’été CEA-EDF-INRIA de juin (2006, 2 weeks) (R. Namyst)
– Participation à la mise en place de l’accord Cadre EDF R&D-INRIA (2009) (R. Namyst et J. Roman)
– Directeur des études des licences professionnelles SIL de l’Université de Bordeaux 1 (P. Ramet)
– Responsable national du projet ANR CIS 2006 SOLSTICE (J. Roman)
– Intervenant à l’école CEA-EDF-INRIA du 6 au 9 novembre 2006, "Calcul scientifique intensif : algorithmes, outils logiciels et applications" (J. Roman)
– Délégué scientifique et président du comité des projets de l’INRIA Bordeaux - Sud-Ouest (depuis 2008) (J. Roman)
– Conseiller scientifique pour le HPC à l’INRIA (J. Roman)
– Membre du comité stratégique du calcul intensif (CSCI) du Ministère (J. Roman)
– Membre du conseil scientifique du CEAM (2009-2012) (J. Roman)
Transversal Project

- ViSiDiA: Visualisation, simulation and proofs of distributed algorithms
  Responsable: M. Mosbah
  Keywords: distributed algorithmics, algorithms visualisation, formal proofs of algorithms, implementation, experiment.

8.1 Assessment of the ViSiDiA project

Permanent Members: P. Castéran, Y. Métivier, M. Mosbah, A. Zemmari
Non Permanent Members (PhD students): V. Filou, M. Tounsi
Non permanents (IR): C. Aguerre
Invited researchers: S. Gruner (Afrique du Sud), A. Habel (Oldenburg, Allemagne), M. Jmaiel (Sfax, Tunisie)

Introduction

Problems related to distributed systems are a major concern of research in computer science. We can particularly mention design and development of distributed architectures, distributed programming environments, specification and verification of distributed algorithms, as well as the study of (wired or wireless) communication networks. For the success of all those undertakings it is crucial to master the mechanisms and small-scale phenomena at the foundations of such systems. This requires the investigation into different models of distributed computation, the development of auxiliary software tools for the visualisation and empirical validation of those models, and the technical expertise for the deployment of distributed systems and platforms. By gathering researchers from different teams, the VISIDIA project aims at establishing a general, integrated methodological framework to deal with both theoretical problems and their practical implications – like effective and efficient implementations – in the field of distributed algorithms. It is expected to provide tools for encoding, studying, proving and teaching distributed algorithms.

Modeling distributed algorithms

Distributed algorithms are difficult to design and to study, and even to represent, mainly when nodes communicating only with their neighbours must participate to achieve a global goal (election of a leader in a network, distributed computation of a spanning tree). Our research group investigates an original formalism in this domain, namely graph rewritings. In this formalism, a distributed system is represented by a labeled graph; the nodes represent the processors and the edges represent the links between them. The labels are used to encode the internal states of processors and/or channels. A rule in such a calculus is defined by a small context graph (used as an ‘anchor’ for application in the host graph) together with two labeling configurations to this context – one to describe the local state before rule application, and one to specify the local state after rule application. The transformation is strictly local; there are no long-distance side-effects.
A rewriting system is defined by a finite set of such rules. In our work, we consider asynchronous rule application: there is no global clock available, and two conflict-free applications of rewriting rules may occur simultaneously, provided they do not attempt to modify the same local context in the host graph. Thus, the behavior of the network is defined by its initial labeling and the rule base of the associated local rewriting calculus.

We consider three types of relabelling rules, called also types of local computations:

LC0 in a computation step, the labels attached to vertices of $K_2$ (consisting of two vertices connected by an edge) are modified according to some rules depending on the labels appearing on $K_2$.

LC1 in a computation step, the label attached to the center of the star is modified according to some rules depending on the labels of the star, labels of the leaves are not modified.

LC2 in a computation step, labels attached to the center and to the leaves of the star may be modified according to some rules depending on the labels of the star.

To obtain machine-executable implementations of algorithms specified by means of these abstract rewriting rules we have to study in particular those probabilistic algorithms of which the synchronization between (two or more) adjacent nodes can be expressed in terms of rewriting rules. This work has been done in the combinatorics team. We have also investigated a model of implementation based on mobile agents.

Local computations and mobiles agents

Mobile agents are a recent paradigm to facilitate the design and the programming of distributed applications. Mobile agents can be useful to implement local computations. More precisely, synchronizations required for executing the above relabeling rules can be done by agents. In such a model, we assume that nodes are passive sites and that mobile agents represent computing entities that apply the rules. One advantage of this model is the separation between the network represented by the nodes and the edges, and the distributed computations represented by the mobile agents. As a consequence a new level of abstraction is introduced between distributed computations and the topology of the network. Such an abstraction is not possible for (classical) models, for instance those based on message-passing where nodes stand for processes and edges stand for communication links. The encapsulation of local computations by mobile agents allows to elaborate solutions that can be efficient and robust. We particularly studied the handshake problem which implements rules LC0. A comparative study for this problem has been done between an agent-based implementation and a message-passing based one. Moreover, we have investigated particular distributed algorithms for mobile agents such as the distributed computation of a spanning tree, agent gathering, information collecting by mobile agents, etc. Using random walks as models of agent movements, we obtained efficient time complexity for these algorithms.

Fault tolerance with ViSiDiA

We have introduced fault-tolerance in the local computation model and in the ViSiDiA platform. We showed how to transform a graph relabeling system encoding a distributed algorithm into an equivalent one which deals with faults. Furthermore, we designed particular rules, called correction rules which can be added to an initial graph rewriting systems in order to encode a self-stabilizing distributed algorithm. We illustrate our approach by various self-stabilizing algorithms including computing distributed spanning trees and computing a correct coloring. An implementation of the designed algorithms is given on the ViSiDiA platform, which allows the user to simulate a faulty node by the graphical user interface.

Formal proofs of distributed algorithms

Recently, we were interested in the use of formal proofs for the correctness of distributed algorithms encoded by local computations. Proving that a distributed algorithm is correct may be
a tedious task, hard to do by hand and even very difficult to be convinced of such a correctness for complex algorithms. To cope with this complexity, it is necessary to develop tools that help being confident in this correctness. Visualization of the executions of algorithms provided by the ViSiDiA platform can be of great help, but confidence can be strengthened by adapting to this kind of algorithms techniques for the development of certified programs using formal methods. Relying on local computations, our work aims at the development of not only particular proofs for isolated algorithms but also the development of generic properties for classes of algorithms. We have started this work by exploring the use of refinement proofs within the ANR project RIMEL. A catalog of proved distributed algorithms has been developed on the RODIN platform together with a tool that generates automatically a ViSiDiA code from a B-event specification of an algorithm. The benefit of such a generation is to implement and to visualize in the ViSiDiA environment distributed algorithms that are formally correct. The high level encoding of distributed algorithms by graph relabeling systems makes it easy the integration of mathematical proofs into distributed algorithms. On the other hand, we are currently formalizing the semantics of local computations with the proof assistant Coq. The aim of this work is to construct a specific (semi-)automatic proof environment for local computations that can be used by non specialists. We have already obtained new results for the class of LC0 algorithms. In addition to a complete proof of an election algorithm in a tree with initial knowledge of degrees, we proved that there exists no election algorithm in a non decorated tree (without initial knowledge of the degrees).

**Highlights, contracts, cooperations**

We have historical relationships with European research groups on “Graph transformations and graph grammars.” We regularly participate to the bi-annual conference ICGT (International Conference on Graph Transformation) and we are involved in the organization of the GCM workshop (Graph Computation Models) which took place already in 2006 and 2008.

As mentioned above, we have a collaboration and an ANR project (RIMEL) with the LORIA and Clearsy on the application of refinement proof techniques to local computations. This work aims to develop a general methodology for local refinement calculations and to develop interfaces between ViSiDiA and RODIN tools. A important goal resulting from this work is the construction of an integrated environment which can automatically generate a distributed algorithm from its high-level specification in B-event to its animation using the software ViSiDiA. We have collaborations with other French teams specialists in formal proofs (Cedric Lab, INRIA Proval, ENS-Lyon) to develop interactive proofs. In addition, we have developed contacts with LIAMA and the ISCAS (China) for a future work on distributed algorithms applied to databases. Indeed, the problems studied at LIAMA on algorithms for distributed data (Netlog language) are close to the approach of local computations, and our aim is to compare the two approaches, and explore the possibility of implementing Netlog queries using ViSiDiA.

We have also collaborations developed with the university of Sfax (Tunisia), namely an exchange researchers project (INRIA / DGRST-Tunisia) in 2006 and 2007. We have three PhD students jointly supervised under this exchange, including a student who has already defended his thesis. Moreover, teaching distributed algorithms for master students with the platform ViSiDiA is used at the universities of Lille, Aix-Marseille and Pretoria (South Africa). We currently have contacts directly with a group of master students at the university of Pretoria who have a project on the platform ViSiDiA, and discover thereby our course offerings and our research works.