

Scientific report 2013
IdEx - Cluster d'Excellence CPU
Report from 01.01.2013 to 31.12.2013



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Evolution of the research units' partners of the project

The list of the research units has not changed since the starting date of the cluster. 6 research laboratories are involved in CPU: le Laboratoire de Recherche en Informatique de Bordeaux (LaBRI – UMR 5800), le Centre de Recherche INRIA Bordeaux-Sud-Ouest, l'Institut de Mathématiques de Bordeaux (IMB – UMR 5251), le Laboratoire de l'Intégration du Matériau au Système (IMS – UMR 5218), l'Institut de Mécanique et d'Ingénierie (I2M – UMR 5295) et le CEA/CESTA.

1. Public summary

Funded by the Initiative d'Excellence of université de Bordeaux since September 2012, the cluster CPU aims at developing numerical sciences at such a level that it can be used as a certification tool. The cluster CPU wants to support, reinforce and develop new collaborations around the mathematics, computer science and scientific computing and to improve the international visibility of the Bordeaux community. In order to reach the objectives, we fund research projects with Post doc, PhD and engineers that are co supervised between different teams in order to enhance interdisciplinarity. We organize also inter disciplinary conferences and local workshops between the axis that can give added value to the community.

Three research axis have emerged:

Axis 1 - « Scientific computing » - IMB, LaBRI, I2M, CEA, INRIA piloted by Angelo Iollo.

Axis 2 - « Signal and image » - IMS, IMB, LaBRI piloted by Jean-François Aujol.

Axis 3 - « Reliability, security & service optimization » - IMB, LaBRI, INRIA, IMS piloted by Akka Zemmari.

In 2013, the teams from different laboratories have integrated their research axis, they have organized working groups in order to establish a common research program in accordance with the strategy and the ambition of the cluster. We have organized a first research call in the beginning of 2013, it is of course too soon to have new scientific results.

2. Progress of the project

a. Organisation – Follow-up

Background

In 2011, the project CPU has not been selected in the first national call « LabEx » (rate B), the reasons were the structure and the scope. The initial project was build through 6 works packages:

WP1: “Innovative numerical methods, on massively parallel computers, for coupled multi- scale and multi-physics flows” - R. Abgrall, P-H. Maire, S. Vincent.

WP2: “Signal and image” - J.F. Aujol, Y. Berthoumieux, J-Ph. Domenger.

WP3: “Reliability of emerging systems” - F. Dufour, C. Maneux, I. Walukiewicz.

WP4: “Numerical methods and High performance and large scale computing” – M.Azaïez, A. Iollo, J. Roman.

WP5: “Network and Service Optimization” - O. Beaumont, Y. Métivier, F. Vanderbeck, T. Ahmed.

WP6: “Codes, cryptography and computational number theory” - C. Bachoc, K.Belabas, A. Enge.

In 2012, we have re organized the project: we have reduced the number of permanents and the scope, we have submitted the new version of the project to an internal submission (IdEx Bordeaux) and international experts have reviewed the proposal.

In July 2012, we have received the external evaluation and some questions have been emphasized about the integration of the work packages in the scientific program. In February 2013, the Scientific Committee of CPU has also reviewed the last version of the project and they have highlighted three problems: the organization, the coherence and the ambition of the project. Following these reports, the steering committee of CPU has decided to set up the different recommendations and have asked the teams to reorganize CPU into three research axis and to propose a common research program with the following goals: reinforce and develop new collaborations around the mathematics, computer science and scientific computing.

Now, the cluster CPU has three research axis:

Axis 1 - **Scientific computing** - Coordinator : Angelo Iollo
Laboratories: Computer science, Math, Mech. Engineering, Nuclear Agency, INRIA.

Axis 2 - **Signal and image** - Coordinator : Jean-François Aujol
Laboratories : Computer science, Math, Electrical Engineering.

Axis 3 - **Reliability, security & service optimization** - Coordinator : Akka Zemhari
Laboratories Computer science, Math, Electrical Engineering, INRIA.

Governance

The cluster is running on a project mode corresponding to the three axis. It is directed by a steering committee formed by the executive director (Th. Colin) and the directors of the associated research units (at the moment: P. Weil (LaBRI), J.-F. Jaulent (IMB), C. Pellet (IMS), E. Arquis (I2M), M.Thonnat

(INRIA), P.-H. Maire (CEA)). The objectives of the steering committee are to analyse and select the best research projects, to follow the scientific vision and the strategy of CPU. Each year through the internal call, the heads of the axis propose scientific actions to the steering committee. The steering committee analyse, approve the best research proposals and follow the realization of the work program.

In 2013, there have been 4 steering committees (*March, July, September, December 2013*) dealing with the selection of the 2013 research projects; the evaluation and selection of the international Post doc and interlabEx campaigns launched by IdEx Bordeaux; the organization of the scientific committee; the internal rules of CPU (for examples, the deadline for the recruitments, the selection of the candidates...).

The cluster CPU has also an international scientific committee formed by national and international experts: I. Bloch (Telecom Paris Tech), E. Chaput (Airbus), H. Common (ENS Cachan), M. Lemme (Univ.Siegen), P. Le Tallec (Polytechnique). The international scientific committee has a consultative role on the scientific and technical orientations of the program; they validate the roadmaps of each axis in research, education and valorisation. In 2013, two scientific committees have been organized: in February 2013, the aim was to analyse the version of CPU (*with the 6 WP*). The second was in December 2013, the objectives were to present the new organization of CPU into 3 axis and to present the perspectives and the scientific strategy for 2014.

One coordinator, nominated by the teams, pilots the axis: Angelo Iollo for axis 1, Jean-François Aujol for axis 2 and Akka Zemhari for axis 3. The roles of the coordinator are to manage the team, to organize working groups in order to establish each year a new common scientific program. They also present the results to the scientific committee and they write the annual report.

A manager has been recruited in March 2013 for one year and a half (part time). Its main missions are to lead the internal organization (research call, scientific committee...), to establish the communication strategy and to participate to the development of the projects. The expenses related to CPU (equipment, consumables, missions...) are made by an IdEx team.

Organisation

At the beginning of 2013, we have organised one internal research call, the heads of the axis have proposed scientific actions for 2013 to the steering committee. The steering committee has evaluated the proposals and has selected the best research projects. These final decisions have been sent to IdEx for validation.

In 2014, we will organize two internal research calls: one to finance the 2014 program of each axis and the other one to finance multidisciplinary projects. The first research call 2014 has started at the end of 2013.

Follow-up

The steering committee is following the scientific program of CPU. In 2013, there have been 4 steering committees (*March, July, September, December 2013*) dealing with the selection of the 2013 research projects, the analyse and selection of the international Post doc and interlabEx campaigns launched by IdEx Bordeaux, the organization of the scientific committee, the internal rules of CPU (for examples, the deadline for the recruitments, the selection of the candidates,...).

At the end of each year, the head of the axis send an annual report in order to present the progress of the work, the results obtained, the socio economic impacts... The reports are sent to the members of the steering committee and the scientific committee for analysis.

The coordinators present their report and their new program to the members of the scientific committee. In 2013, it has been organized on December 4, 2013. The general feeling was that the remarks did in the past (*problems regarding the coherence, ambition and scope of the project*) have been taken into account. The new organization is successful. The members of the Scientific Council have highlighted and appreciated the new collaborations created inside and between the axis. The structure of CPU is better than last year, it is clearer, CPU starts to live; it is largely due to the joint PhD and Post doc.

In 2013, the direction of CPU has presented the progress of the cluster CPU to the members of the Comité de Gestion IdEx (on October 15, 2013 by Pascal Weil) and the Comité Stratégique IdEx (on December 9, 2013 by Thierry Colin).

On a daily basis, the manager in collaboration with the Director is following the administrative and technical part of the financed projects.

b. Results achieved

Research

9 research projects have been launched and financed in 2013, below you will find the progress of the work and the results for each axis of CPU.

- **AXIS 1 – Scientific Computing**

The research projects included in the theme numerical modeling and HPC are collaborative efforts involving teams of mathematicians, fluid mechanics and computational scientists working on major software and algorithm development for applications to problems in Energy Sciences, Advanced Scientific Computing Research, Fusion Energy Sciences, and Biological and Environmental Research. In 2013, we have identified three main subjects that will be the focus of our project:

- Numerical medicine including tumor growth modeling and cardiac electrophysiology;
- Numerical materials, meaning the simulation of virtual materials from the micro to the mesoscale;
- Multi-physics and multi-scale flows occurring in aerospace/ environmental/chemical /nuclear engineering.

Relative to these objectives, several activities have been financed both in terms of human resources and in terms of conference and mobility funding. Some of the activities were postponed because of an initial delay in the availability of the funds.

Up to now, 3 research projects have been funded:

Project 1: Alan Tassin, Postdoc at I2M (24 months) concerned with air-water interaction in environmental flows. Allan Tassin has been recruited on December 2013. The supervisors are S.Glockner (I2M), P.Lubin (I2M), L.Mieussens (IMB), P.Ramet (LaBRI) et F. Veron (Univ of Delaware – USA). Alan Tassin has decided to resign in order to accept a permanent post at IFREMER (End of the contract on December 31st, 2013). A new recruitment is in progress.

Project 2: Gabriel Georges, PhD at Celia concerned with high-order ALE-AMR methodologies devoted to the numerical simulation of multi-material compressible fluid flows for solving multi-dimensional Lagrangian hydrodynamics (*cofounded with the DRA*). Gabriel Georges has been recruited on September 2013. The supervisors are PH.Maire (CEA-IMB) and J.Breil (CELIA).

Project 3: Quentin Viville, PhD grant at Inria concerned with penalization methods and level sets methods for numerical simulations of moving bodies in compressible flows. Quentin Viville has been recruited on September 2013. The supervisors are R.Abgral (IMB-INRIA), C.Dobrzynski (IMB-INRIA) and H. Beaugendre (IMB-INRIA).

In order to reinforce the dissemination of the results and to share knowledge, CPU has funded several missions for its members to participate to international and national conferences. For more details, please refer to the part "*Actions – Transfer of knowledge*".

Workshops in Bordeaux have also been co-funded in order to enhance the scientific debate around the thematics of axis 1 and to reinforce the international attractiveness of the universit  de Bordeaux.

- **AXIS 2 - Signal and image:**

The Project carried by this axis of CPU is designed to meet the scientific challenges by leveraging strong interactions between mathematics, signal processing and computer science. The consequence of the quantity and complexity of natural data measured with more powerful sensors is that most existing analysis methods are useless against the specific characters of this new kind of data which are often non-stationary, multi-scale, evolutionary and characterized by complex statistical dependencies in terms of scale, time and geometric components. The innovation in this framework will also pass through the exploitation of new concepts for the signal and image community: revisited sampling theory, new definitions of functional in non-Euclidean spaces, new kinds of specific constraint in optimization procedures such as positivity or local-regularity, or working on specific manifolds. These works include new developments such as:

- Inverse problems,
- Bayesian and variational methods,
- Non local methods, patch comparisons,
- Convex optimization,
- Methods dealing with invariance or multi-scale issues,
- Estimation methodologies, classification and segmentation.

Up to now, 2 research projects have been funded:

Project 1: Moncef Hidane, Postdoc (2013-2015). The supervisors are Jean-Francois Aujol (IMB), Charles Deledalle (IMB) and Yannick Berthoumieu (IMS). An industrial partner is involved in the research project: TOTAL Compagny. Moncef Hidane joined the team on September 2013 for a post-doctoral position. He defended his PhD thesis on the 22 March 2013 on the subject: "Multi-scale Decomposition of Functions Defined on Graphs" at the University of Caen Lower Normandy. The subject of this post-doc concerns the reconstruction of 3D images from a complete low-resolution acquisition and a high-resolution but occluded acquisition. It is a super-resolution inverse problem. The forward model adopted for the low-resolution data is a convolution followed by a down-sampling operator in the spatial or spectral domains. An additive white noise is added to the model. The forward model adopted for the high-resolution data is a deterministic occlusion operator with known support. An additive white noise is also added to the model. The first direction followed is a regularization based on total variation. Two versions are considered: with inequality constraints and with equality constraints. In this context, an important part of the work concerns the minimization of the energy functions in each case. Due to the non-differentiability of the total variation semi-norm, recent algorithms from the field of non-smooth convex optimization are considered. The goal is to have fast and robust minimization algorithms.

A future second direction concerns the use of non-local regularization operators. The challenge is to

use both the low-resolution and high-resolution data in order to conceive the non-local regularization term.

Project 2: Fabien Pierre, PhD (2013-2016). The supervisors are Jean-Francois Aujol (IMB), Aurélie Bugeau (LaBRI) and Vinh Ta (LaBRI). One industrial partner belongs to the project: Technicolor Research Rennes. Fabien Pierre graduated as best student of master TDSI (Traitement du Signal et des Images). His PhD thesis is about *Image colorization by variational methods*. The problem is to colorize a gray scale image by using the color palette of another one. Comparisons between patches are used. The question of how to compare the patches is a central one. A criterion is to be defined, whose minimizer should give the colorized image. Modeling is a critical issue. Then efficient numerical strategies are to be developed. This study is done with the expertise of researchers from Technicolor Rennes. This trend of research also belongs more generally to the research axis on "Minimization of nonlocal functionals for image processing". An ANR Project, MINIMAX, has been submitted.

Signal-image seminars, co-organized by IMS, IMB and LaBRI and supported by CPU, proposed regular scientific presentations on topics such as methods, models, algorithms for image and signal processing purposes. In 2013, eight different speakers presented their recent works in six different seminars. Image working groups are also organized each month, the purpose is to discuss on specific topics in image processing and image analysis in order to enforce the synergy between IMB / IMS / LaBRI and to improve collaborative research and knowledge sharing. Nine working groups have been set up since in 2013. The Image working group is an opportunity for deeper and less formal discussions between researchers and the perfect place to establish new emerging collaborations. The discussion usually takes place after presentations of local researchers or invited speakers and takes the form of a round table.

A Workshop "Remote Sensing days" has also been organized in November 2013 in order to present the latest developments in segmentation of aerial and satellite images.

Several invitations have been financed: A good example of the efficiency of such invitation is the following one: *For example, the visit of Camille Rueda: The aim of this collaboration was to study temporal formalisms for signals and events organisation. The challenge of this study was to find a new model based on a convenient combination of low-level synchronous aspects with real-time events asynchronous aspects, and providing formal checking of certain properties. We studied synchronous and asynchronous composition of multimedia processus in an interactive sequencer. Such programs are constituted with compositions of processus to command multimedia inputs and outputs that are either static or real-time, and according a partially predefined scenario based on a time-line in the i-score sequencer. We have worked out a new model that we have simulated with the CPN software. The results are the following:*

- i) A patent for an invention is currently pursued;
- ii) On or two papers will be written and published as soon as the patent is accepted;
- iii) The model will be implemented in the i-score software as soon as possible.

- **AXIS 3 - Reliability, security and service optimization**

In the last few decades, we have experienced a large growth of the use of heterogeneous and cooperating systems and networks. Indeed, networks appear in Internet and distributed/parallel computers and also in more recent systems including peer-to-peer systems, cloud and sensor networks.

Designing applications for such complex systems becomes more and more challenging. These applications have to be run on many entities. Each entity may have its own hardware, code and independent task. Nevertheless, nodes may share some common resources and/or exchange information to solve a common problem. Sometimes the nodes can be assumed to work correctly

and sometimes they may have an erroneous or malicious behavior.

This research axis addresses these emerging systems in a continuum starting from the physical realizations to high-level models. It aims to devise models and tools to study such complex systems and brings together researchers working on networks under different considerations.

Up to now, 4 research projects have been funded:

Project 1: Chhandak Mukerje was recruited in October 2013 for a 3-years post-doc on graphène circuit reliability. In December 2013, we have invited Frank Schweirz, from the Ilmenau University of Technology in Germany to exchange on methodology to assess the graphene transistor failure mechanisms before implementing them into its compact model.

Project 2: Edon Kelmendi has started his thesis the 1st October 2013 under supervision of François Dufour (INRIA) and Hugo Gimbert (LaBRI, CNRS). The objective is to work on numerical methods for optimization and synthesis of strategies in games with continues state spaces.

Project 3: Issam Tahiri: a research engineer (24 months) was recruited in the project visidia. He works on the definition of a language that can be used to specify distributed algorithms encoded using local computation rules. This definition can be used to certify and prove such algorithms and/or to test, validate and visualize their execution. The CPU finances this recruitment. The supervisors are F. Vanderbeck (IMB), T.Ahmed (LaBRI), Y.Métivier (LaBRI) and O.Beaumont (LaBRI).

Project 4: Wahadou Abdou: a research engineer (24 months) has been selected to work on the software platform Bapcod. This suite offers exact optimization (bringing a certification on the deviation to optimality) to handle large scale decision aid problems by way of decomposition methods. Such platform is a tool for technology transfer within and outside the workpackage (hence a mean for building collaborations). The supervisors are: M.Mosbah (LaBRI) and P.Casteran (LaBRI).

A PhD thesis has been offered on the subject of identifying codes, co-supervised by Christine Bachoc (IMB) and Arnaud Pêcher (LaBRI). Unfortunately it could not start this year due to the withdraw of a candidate. This thesis will be launched in September 2014.

Thanks to CPU, different activities (*seminars, local workshops, invitations, seminars, international mobility...*) have been conducted inside the axis and in interaction with some well-known researchers that we were be able to invite. **For example: the visit of Professeur Alexey Piunovskiy:** *we have worked on continuous-time Markov decision processes on a general Borel state space with both impulsive and continuous controls for the infinite-time horizon discounted cost. The continuous-time controlled process is shown to be non explosive under appropriate hypotheses. The so-called Bellman equation associated to this control problem is studied. Sufficient conditions ensuring the existence and the uniqueness of a bounded measurable solution to this optimality equation are provided. Moreover, it is shown that the value function of the optimization problem under consideration satisfies this optimality equation. Sufficient conditions are also presented to ensure on one hand the existence of an optimal control strategy and on the other hand the existence of an e-optimal control strategy. The decomposition of the state space in two disjoint subsets is exhibited where roughly speaking, one should apply a gradual action or an impulsive action correspondingly to get an optimal or e-optimal strategy. An interesting consequence of our previous results is as follows: the set of strategies that allow interventions at time $t=0$ and only immediately after natural jumps is a sufficient set for the control problem under consideration. **This work has been submitted to an international journal).***

Education

The overall vision of CPU regarding the education part is to develop and reinforce the partnership with ENSEIRB-Matmeca and the Masters of the University of Bordeaux. Some actions have been emphasized:

- To build a new academic program on scientific computing at ENSEIRB-Matmeca.
- To give access to the platform PlaFrim to the students.
- To fund international internships through the agreement with the Hô-Chi-Minh University (Vietnam) and the partnership with India.

These projects will create something more coherent, some discussions have been settled in order to improve the master program. CPU has to prepare this ambitious project and has to be the leader and initiate the change. Due to internal difficulties at the University, the education part of CPU can't be developed for the moment.

To reinforce the international collaborations, at the end of 2013, we have begun to organize the venue of 5 interns from Ho-Chi Minh University in the framework of the master franco-vietnamien.

Valorization

The community of CPU is used to work with industrial partners; we have several research contracts, which integrate companies (for examples: TOTAL, Thales...). Their participations are either financial, or in nature (database, code sharing...). For more details, please refer to the part "*socio economic impacts*" described below.

Perspectives 2014

Our goals for 2014 are to develop the relationships with other LabEx/disciplines, to confirm axis 1 and 2 and to reinforce the dynamics of axis 3. The tools we plan to set up are to use the funding in an initiative way and to build a CPU community that can be efficient even for education.

Moreover, following the recommendations of the Comité Stratégique IdEx, we have decided to organize a research call in March 2014 in order to fund multidisciplinary projects. In fact, the thematics covered by CPU are transverse to several disciplines. Numerical is a key point for the Bordeaux community. We would like to reinforce the interactions and collaborations with the site in sharing competences and knowledge.

Regarding the valorization program, we would like to reinforce the socio economics contacts and to develop CIFRES. We plan to co fund PLAFRIM2 (*interactive joint platform dedicated to Research, between all the labs involved in CPU*: <https://plafrim.bordeaux.inria.fr/doku.php>).

Some problems and how we solved them

We have two distinct parts in CPU: Scientific Computing and Network and reliability. It is almost impossible to merge. The solution is to run it separately. The weight of the laboratories is also important in CPU, they want to keep their own strategy. The solution we set up is that the laboratory directors are strongly involved in the governance of CPU.

We would like to obtain real multidisciplinary collaborations: the axis 1 and 2 have succeeded in working together. The axis 3 has to reinforce its dynamic and its collaborations. We have decided to fund only collaborative projects and only actions with added value for the community.

The cluster CPU has existing collaborations with the IHU, with medical imaging (TRAIL, 2 joint projects). We have begun to discuss with the labEx AMADEus, LAPHIA, The SIRIC, BRAIN, COTE. We have to continue the discussion and to develop the interactions with other LabEx. We plan to set up interlabEx seminars.

3. Human resources

Permanent positions

Regarding the permanent positions or the educational programs, at the time being, there is no link with the strategy of the universit  de Bordeaux, the cluster CPU is never consulted. It is the same for the non-permanents that are funded by the University.

For information purpose only, you will find distinctions from 2009 to 2013 (*Source IdEX – March 2014*):

- Two IUF (in 2009: Cyril Gavaille; in 2013: Jean-Fran ois Aujol).
- One “Laur at du Grand Prix de l'Acad mie des Sciences Louis Gentil - Jacques Bourcart” in 2013 : Pierre Lubin.
- One “M daille d'argent” from CNRS (2010: Anca Muscholl).

CPU recruitments in 2013

In 2013, through the 9 research projects, CPU has recruited 9 persons (3 Post doc, 4 PhD, 2 engineers):

AXIS	Name	Position	Months	Lab	Subject	Supervisors
1	Alan TASSIN <i>Resignation on December 31st 2013</i>	Postdoc	24	I2M	Air-water interaction in environmental flows	S.Glockner (I2M), P.Lubin (I2M), L.Mieussens (IMB), P.Ramet (LaBRI) et F. Veron (Univ of Delaware – USA).
1	George GABRIEL	PhD	36	CELIA	High-order ALE-AMR methodologies devoted to the numerical simulation of multi-material compressible fluid flows for solving multi-dimensional Lagrangian	PH Maire (IMB – CEA), J.BREIL (CELIA)

					hydrodynamics	
1	Quentin VIVILLE	PhD	36	IMB	Penalization methods and level sets methods for numerical simulations of moving bodies in compressible flows	R.Abgral (IMB-INRIA), C.Dobrzynski (IMB-INRIA) et H. Beaugendre (IMB-INRIA)
2	Fabien PIERRE	PhD	36	IMB	Image colorization by variational methods	Jean-Francois Aujol (IMB) – Aurélie Bugeau (LaBRI) – Vinh Ta (LaBRI)
2	Moncef HIDANE	Postdoc	24	IMS	The reconstruction of 3D images from a complete low-resolution acquisition and a high-resolution but occluded acquisition	Jean-Francois Aujol (IMB) – Charles Deledalle (IMB) – Yannick Berthoumieu (IMS),
3	Chhandak MUKERJE	Postdoc	24	IMS	Graphene circuit reliability	Cristell Maneux (IMS), François Dufour (IMB), I. Walukiewicz (LaBRI)
3	Edon KELMENDI	PhD	36	LaBRI	Numerical methods for optimization and synthesis of strategies in games with continues state spaces.	François Dufour (INRIA) and Hugo Gimbert (LaBRI, CNRS)
3	Wahadou ABDOU	Engineer	24	LaBRI	Software platform Bapcod	M.Mosbah (LaBRI) P.Casteran (LaBRI)
3	Issam TAHIRI	Engineer	24	IMB	The definition of a language that	F. Vanderbeck (IMB), T.Ahmed

					can be used to specify distributed algorithms encoded using local computation rules (visidia project)	(LaBRI), Y.Métivier (LaBRI), O.Beaumont (LabRI)
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Procedure

We have established an internal procedure that is i) the diffusion of the job offers (CPU and IdEx websites, local and international networks...) except for the supervisors who have a candidate for the project. ii) The supervisors make the pre selection of the profile. iii) The candidate selected has to be approved by the steering committee.

Each recruitment has to be co supervised by two members of CPU (minimum) from different laboratories. We strongly recommend the supervisors to focus on international profiles and/or a profile with a strong international mobility.

We have decided to set up one criterion of ineligibility: A Post doc with a PhD done in Bordeaux will be ineligible.

Regarding the internships, CPU supports international applications in order to enhance the attractiveness of the university. It is also the way to see if the profile of the master student can match with an eventual PhD.

4. Socioeconomic impacts

In 2013, each axis has initiated discussions with industrials. The activities with regional, national and international companies of the members of CPU include interactions with numerous companies like Dassault, Airbus, Onera, Cerfacs, Irstea, Institut Bergonié, IHU Liryc, ABENGOA, VALEOL, PlasticOmnium, DGA, Inserm. With these companies or research institutes we have partnerships that are based on research contracts, PhD funding, CIFRES, code sharing, personnel training.

One of the priorities of CPU is to develop and reinforce the links with SME and large companies, as there is a real potential. Below, we have described the different actions set up by the research axis with industrial partners during this year:

- **Axis 1**

A half-day meeting with Herakles (Safran group) was held at Inria in the framework of CPU activities. Herakles is a European leader for rocket propulsion in defense and space applications. The technical director of Herakles and the structure and engineering division heads were present. Reciprocal presentations focused on technical needs and specific numerical savoir-faire in numerical certification of CPU. Two main subjects of mutual interest were identified i) Numerical materials; ii) Propagation of uncertainties. Following this meeting, Pietro Congedo (Inria) has fixed a presentation day at Herakles on uncertainties. For numerical materials, further actions are to be organized in coordination with Amadeus LabEx. On November 20th, 2013 such coordination day took place with mutual presentations CPU/Amadeus of the scientific objectives.

- **Axis 2**

Total company and Technicolor Research Rennes are involved in two research projects of CPU. The aim is to develop the partnerships. Thanks to CPU, a 2014 ANR project proposal MINIMAX with Technicolor Research Rennes company has been submitted. Thanks to CPU funding, meetings with Technicolor Research Rennes were conducted, that could create a synergy around communal media applications. Technicolor provides case studies for research axis 2 of CPU. Another 2014 ANR project proposal MICRO-BIOMARK on identification of biomarkers by mass spectrométrie -- Expérimental study with application to microbiology has been submitted with Laboratoire Biostatistique-Santé (Lyon), IMS (Bordeaux), bioMérieux (Lyon) and Plateforme Protéomique (Dijon). We wish to thank the TOTAL group for scientific exchanges involving many open issues in image processing. Specialized in geosciences, the TOTAL group address many major scientific issues and provides challenging datasets perfectly consistent with the objectives of the axis 2.

Part of the action of the research axis 2 is related to Thales thanks to Albatros GIS. The Albatros GIS is a Scientific Alliance with Thales Avionics, Thales Defense Mission Systems and all the research and Academic entities of the Bordeaux Campus including the INRIA. Its goal is to develop the relationships among the Thales engineers, University professors and researchers. It covers a large range of disciplines from Human cognition, HSI, augmented reality, distributed systems, image and signal processing and advanced IC's, optics and materials. Cockpits, mission systems, drone are the typical field of applications. Albatros act as a think Tank providing new partnership research opportunities fostering Innovation for our Society.

- **Axis 3**

The team of axis 3 is settling collaborations with Thales Avionics S.A. to propose a join answer to the European call "the issue" of H2020. This collaboration has been initiated within the Competitiveness Cluster Aerospace Valley. They have also proposed to organize a meeting in collaboration with the Competitiveness Cluster Aerospace Valley to define and explain the criticism of the emerging memory technologies reliability for embedded calculator's systems in the transportation context.

In 2013, the direction of CPU has met the Fondation Bordeaux Université and two projects are in progress:

- Thematic: Modelling of tumour growth – Thierry Colin. Industrial contacts: Novartis (in progress) and Sanofi (in progress). These projects are in partnerships with Institut Bergonié, CHU haut-Lévèque & Pellegrin.
- Thematic: Operational research for logistics – François Vanderbeck. Industrial contact: GT Logistics- Eric Sarrat (negative answer). New project (in progress) on "decision support tool for vineyards maintenance" with Château Chaspine.

5. Actions – Transfer of knowledge

In 2013, CPU has funded numerous motilities to participate to national and international conferences in order to present the results. Some examples are listed below.

- **Axis 1**

BOQUSE 2013; Euromech Colloquium 555; Numerical Mathematics and Applications to Some Challenging Problems; Kinetic equations and applications, University of Delaware; University of

Queensland; Research Department of Abengoa a Spanish industrial company, French/Chinese research days in Xiamen...

- **Axis 2**

The Sixth Annual World Molecular Imaging Congress, 2013- Georgia; International Society of Magnetic Resonance in Medicine - Salt Lake City; European Society for Therapeutic Radiology and Oncology- Switzerland; 10th IEEE International Symposium on Biomedical Imaging (ISBI) - California; Workshop dual PhD France-USA; Computational Surgery&Medicine - Houston, Texas; SIAM Conference on analysis of PDE, Orlando, US; ESMRMB 2013 Congress; HARDI Reconstruction Challenge; Congrès GRETSI; Innovation in Medicine & Healthcare - Greece; 21st European Signal Processing Conference (EUSIPCO); IEEE International Conference on Acoustics, Speech, and Signal Processing - Canada; Groupe d'Etudes du Traitement du Signal et des Images (GRETSI)) Brest; IEEE International Conference on Image Processing - Australie ; IEEE International Geoscience and Remote Sensing Symposium - Australie ; ICASSP 2013 - États-Unis; RITS - Recherche en Imagerie et Technologies pour la Santé - France; ICIP 2013 – Australie; Congrès SMAI - Seignosse...

- **Axis 3**

Gandalf'2013 workshop; Fourth International Symposium on Games, Automata, Logics and Formal Verification; ATVA 2013 and GAMES 2013; CAS 2013 Conference, Bucarest - Romania; 2013 International Semiconductor Conference (ISCDG)-Germany; IEEE BCTM Bordeaux; SIROCCO 2013-Italy; ADHOC-NOW - Poland; DISC 2013 - Israel; EURO INFORMS 26, Rome; AINA 2013 - Spain; BDA 2013 – Nantes-France; 4th SDP days, CWI, Amsterdam; 4th Workshop on Fourier Analysis and Related Fields, Renyi Institut of Mathematics, Budapest; Delaunay Geometry: Polytopes, Triangulations and Spheres - Freie Universität Berlin; Méthodes arithmétiques et applications-Besançon; GEOCRYPT2013, Papeete; JCB 2013 Journées de combinatoire de Bordeaux; Indo-Slovenia Conference on Graph Theory and Applications-Inde; CID'2013, 15th workshop on graph theory – Poland; Center for Advanced Studies- Oslo; 4th Workshop on Fourier Analysis and Related Fields, Renyi Institute- Budapest; Nord-Pas-de-Calais/Belgium Congress of Math, Mons; PODC 2013: ACM Symposium on Principles of Distributed Computing; International Conference in Discrete Mathematics - India; Eurocomb'13 – Italie; Arithmetic Geometry – Moscou; Geocrypt, Tahiti; Selected Area in Cryptography, Vancouver; . Journées du Lirima, Rabbat; Arithmétique, géométrie, cryptographie et théorie des codes (AGCT); 15th Workshop Colourings, Independence and Domination - CID 2013-Poland; International Workshop on Combinatorial Algorithms - IWOCA 2013; European Conference on Combinatorics, Graph Theory and Applications - Eurocomb 2013 ; IEEE Symposium on Information Theory, ISIT 2013 – Istanbul...

6. Actions - Promotion & communication of the cluster

In order to present the cluster CPU and to initiate collaborations with University of Houston (US), two members of CPU (the director and the coordinator of axis 1) have been in United States. In 2014, we plan to develop this kind of actions to reinforce the international network of CPU.

7. IdEx relationships

The cluster CPU is funded by the Initiative d'Excellence of the université de Bordeaux therefore the cluster CPU belongs to the IdEx program. Each decision regarding the budget has to be sent and approved by IdEx. Once it is approved, IdEx gives the funds to CPU. There is a lack of reactivity, we often lost time and it is delayed the starting date of the project.

In 2013, the direction of CPU has presented the progress of the cluster CPU to the members of the

Comité de Gestion IdEx (in October 15, 2013) and the Comité Stratégique IdEx (in December 9, 2013).

The members of the cluster CPU applied to the research call of IdEx: InterlabEx projects, international Post doc, Junior and Senior Chair, invited professors... In 2013, the Cluster has been selected for a Post doc position (Salem SAID, IMS) and an interlabEx project (TRAIL/CPU – managed by Jérôme Saracco).

IdEx organize meetings and working groups with the Directors of the LabEx and Clusters in order to present the program and consult them.

8. List - 10 major publications of the cluster CPU in 2013

On the theta number of powers of cycle graphs

C. Bachoc, A. Pêcher, A. Thiery
Combinatorica, Vol. 33, No. 3 (2013), 297-317.

SiGe:C HBT Technology with 1.65 ps gate delay

Mario Weiß, Cedric Majek, Amit Kumar Sahoo, Cristell Maneux, Olivier Mazouffre, Pascal Chevalier, Alain Chantre, Thomas Zimmer
IEEE Electron Device Letters, Volume 34, Number 10, pp 1214 - 1216, 2013.

On the time and the bit complexity of distributed randomised anonymous ring colouring

Yves Métivier, J. M. Robson, Nasser Saheb-Djahromi, Akka Zemmari
Theor. Comput. Sci. 502: 64-75 (2013).

A nominally second-order cell-centered Lagrangian scheme for simulating elastic-plastic flows on two-dimensional unstructured grids

Maire, Pierre-Henri; Abgrall, Remi; Breil, Jerome; et al
JOURNAL OF COMPUTATIONAL PHYSICS Volume: 235 Pages: 626-665 Published: FEB 15 2013.

Theoretical investigation of the efficacy of antiangiogenic drugs combined to chemotherapy in xenografted mice

Lignet.F, Benzekry.S, Wilson.S, Billy.F, Saut.O, Tod.M, You.B, Adda Berkane.A, Kassour.S, Wei.M.X., Grenier.E, Ribba.B
Journal of Theoretical Biology, 320, pp. 86-99. (2013).

A substructuring method for phase change modelling in hybrid media

F. Jelassi, Azaïez M., E. Palomo Del Barrio
Computers & Fluids 88 81–92. (2013).

An evaluation of the sparsity degree for sparse recovery with deterministic measurement matrices

Y. Berthoumieu, Ch. Dossal, N. Pustelnik, F. Turcu, and Ph. Ricoux
Journal of Mathematical Imaging and Vision, Vol. 48, pp. 266--278, 2013.

Variational Exemplar-Based Image Colorization

Aurélie Bugeau; Vinh-Thong Ta, Nicolas Papadakis
IEEE Transactions on Image Processing, 2013, TIP-10396-2013.

High-dimension multi-label problems: convex or non convex relaxation?

N. Papadakis, R. Yildizoglu, J-F. Aujol and V. Caselles
SIAM Journal on Imaging Sciences, volume 6, number 4, pp 2603-2639, 2013.

In vivo mathematical modeling of tumor growth from imaging data : soon to come in the future ?

F. Cornelis, O. Saut, P. Cumsille, D. Lombardi, A. Iollo, J. Palussiere, T. Colin

Diagnostic and Interventional Imaging, Vol 94, Issue 6, Pages 571-674 (June 2013).

Free comments

We need a manager (full time) for running the project. There is a crucial lack of support functions to manage correctly the program (communication, administrative part, organization and accommodation for the interns,...). With the support of the Directors of the clusters, an email has been sent on March 3rd, 2014 by the manager to alert the Coordinator of IdEx about the situation.