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INédit

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NATIONAL INSTITUTE FOR RESEARCH IN COMPUTER SCIENCE AND CONTROL

INRIA

NEWS

CONTENTS

Maximizing the economic impact of our research

Interview with Bruno Sportisse, Director for technology transfer and innovation

INRIA's technology transfer strategy is today based on two priorities: a renewed focus on a few key industrial partners and stepping up transfers to SMBs (small and medium size businesses). With one goal in mind: ensuring its role as a national player in technology transfer in its field of expertise.

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INédit : What new directions are being taken by the Institute's technology transfer strategy?

Bruno Sportisse: We have had to change our policies in order to enhance the effectiveness of our transfer operations and take into account new means of supporting innovation. In a context where strong regional organizations are growing ever stronger, such as competitiveness centers and organizations for pooling commercial uses of public research, INRIA has to reassert its position as a national institute in this sector. Our role is to bring the regions into contact and share our experience with ICST technology transfer and innovation. The reorganization of the technology transfer and innovation department that we undertook a year ago aims to guarantee our role as a national player in ICST transfers in partnership with all of those regional organizations.

INédit : In concrete terms, what changes have been made?

Bruno Sportisse: They vary greatly depending on the type of transfer in question. The transfer of ideas is at the nexus of our collaborative activities with the major industrial groups. Our priority is to refocus on a reduced number of major strategic groups in our field, essentially as part of bilateral partnerships. Those partnerships are intended first of all to give us access to interesting research challenges to which the Institute will devote a level of commitment surpassing that of the teams taken individually. The activities we are currently setting up with EDF's R&D on high-performance simulations follow this approach. Since they are bilateral, these relationships also allow us to create a privileged link at a time when corporations are leaning more toward investing in multi-partner collaboration—as part of French or European tenders—which tend to subdivide our relationships and involve substantial preparation and monitoring costs.

Skills transfers mainly concern the expertise for which we clarified the context in 2008. We are now working on a mobility plan intended to motivate researchers engaged in projects with industry to either go work for the partner for some period of time or invite someone from industry to join their team.

Lastly, technology transfer can occur in a number of ways, ranging from the creation of companies to the concession of licenses, going by way of the distribution of free software and standardization. The changes made in this domain are equally significant and supported by a desire to move from an advisory role to an environment where transfer actions are designed jointly. One key point is the priority commitment by the Institute to expanding transfer in all of its forms for the benefit of the SMBs.

> "Transfers to SMBs must be built around the competitiveness centers"

INédit : How will this desire for joint design work in practice?

Bruno Sportisse: In order to consolidate our transfer activities, a steering committee was set up in January 2009. Its role is to monitor transfer projects further upstream, to ensure follow up over time and to provide the Institute with decision-making criteria. We are thus in a position to support projects based on criteria specific to each transfer, meaning it's more "market drawn" than "technology driven". Changes under way at INRIA-Transfer, our

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Toward green computing platforms

Kicked off in 2008, the Green-Net collaborative research project intends to add a significant quality criterion to distributed infrastructures that supplements those of performance and service quality: energy consumption.

It will soon be possible to reduce the electric energy consumption of a distributed infrastructure of the data center or computational grid category. In fact, researchers from the Reso and Mescal teams, along with their colleagues at IRIT in Toulouse and Virginia Tech University in the U.S., are developing environmental software to control electricity usage. The idea is quite simple since it involves adapting the power of available resources to computational demand and turning off machines not in use for extended periods of time (more than 5 minutes). However, putting this into practice raises a number of problems that these researchers are studying on the Grid'5000 experimental platform. First of all one has to be able to predict off-line periods based, for example, on times of the day or year, using analysis of platform uses. To do so, the Green-Net researchers have deployed sensors used to measure in real time the consumption of 18 computational nodes at three Grid'5000 sites. One full set of sensors will be deployed in 2009 for all of the 150 nodes at the Grid'5000 site in Lyon. The Reso team was thus able to offer a resource conservation model that can directly analyze usage and make predictions for periods when machines are off line.

That said, a few precautions must be taken before shutting machines down! The researchers at IRIT envision a trust-based arrangement so that off-line computational nodes can always be considered to be available (rather than defective) and so that basic services can be provided by another machine. The Mescal team is working to ensure that request sequencing takes into account periods of non use, and the American researchers, who have created a system for classifying heavy-use computational centers based on energy efficiency (Green500.org), are assessing the savings obtained.

"We are also trying to give preference to off-peak periods by proposing reservation times that permit one to aggregate computations," adds Laurent Lefèvre, Green-Net's coordinator. *"For a platform like Grid'5000, one can thus manage to obtain a 30-35% energy savings for the year, which is equivalent to the consumption of a village of 600 residents over that same period of time!"* Researchers are presently beginning to integrate all this software into a single package. Validation of the complete product should take place this year at the Grid'5000 site in Lyon.■

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Maximizing the economic impact of our research

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subsidiary in charge of start-ups, constitute part of this approach.

INédit : *How can transfers designed to benefit SMBs be enhanced?*

Bruno Sportisse: One critical aspect is that we first have to identify them! We then have to define their real needs before launching into a costly process of technological maturing.

To do so, we have reorganized technology transfer around five national sector managers tasked with identifying SMBs that are innovating in their market sectors and matching them up with research work being done at INRIA. In practice, the competitiveness centers must become a leverage point for improving our knowledge of local SMBs. At the same time, we are stepping up efforts based on networking of the Institute's research centers in order to go beyond the regional level of operations. This approach should allow an SMB in Lille to be linked up with an INRIA team in Grenoble, for example. A special support mechanism intended for SMBs has also been set up, based on a joint laboratory concept combining an INRIA team and an SMB (I-Lab).

We are also concerned about creating a propitious environment for this type of transfer. Thus it is that, on December 15, 2008, in the wake of the SMB agreement launched in 2005 by the Richelieu Commission and Oséo to facilitate relationships between major accounts and SMBs, INRIA

QUANTIFYING THE EFFECTS OF ACIDIFICATION OF OUR OCEANS

On January 30, the Monaco Declaration[1] alerted the world to the threat posed to our oceans by the increase in carbon dioxide in the atmosphere. In effect, the increase in this greenhouse gas is accompanied by a rise in the amount dissolved in our oceans. However, far from stimulating the trapping of this carbon—which would help solve the problem of global warming—this augmented dissolution leads to acidification of the marine environment that could well slow down biological activities. This is what is emerging more and more from research findings, including those of the oceanography laboratory at Villefranche-sur-mer (UPMC-CNRS) and INRIA's Comore team, specialized in the modeling and management of natural resources. These researchers, who are participating in the ANR Boom project and the European Epoca project, are modeling carbon flows between the atmosphere and the oceans and assessing the impact on marine organisms of changes they undergo. To this end, they have chosen the coccolithophorids, which play a preponderant role in the carbon cycle and thus in mechanisms that regulate atmospheric levels of CO_2. These microscopic, single-cell algae consume CO_2 for photosynthesis but also in order to produce their calcarian skeleton which, when they die, may become sediment on the ocean floor and form part of the chalky cliffs of Etretat, for example.

How will these organisms react to greater acidification of the oceans? Studies done to date suggest for the most part that the calcification process is reduced. Whence our interest in better understanding those calcification mechanisms and identifying which conditions favor them. When it dissolves, carbon dioxide reacts with water to form various types of ionic and non-ionic chemicals. The Comore team and its colleagues at Villefranche-sur-mer have developed and analyzed control models based on various scenarios, and have compared them to in vitro test results. These researchers have thus been able to show that acidification of the marine environment leads to a lower availability of the carbonate ions that seem to be essential to regulating the calcification process. *"We still have to transpose these results to the whole ocean," notes Olivier Bernard. "But, even though still partial, these results suggest that we take a second look at solutions that involve injecting CO_2 into the sea...!"*

[1] *The Monaco Declaration was made public on January 30 upon completion of the 2nd International Symposium on "The Oceans in an Overly Acid World". This declaration was signed by more than 150 major figures in marine sciences, from 26 countries, with the aim of calling on decision-makers to take steps to reduce CO_2 emissions. http://www.science.gouv.fr/fr/actualites/bdd/res/3055/acidification-des-oceans-l-appel-de-monaco/*

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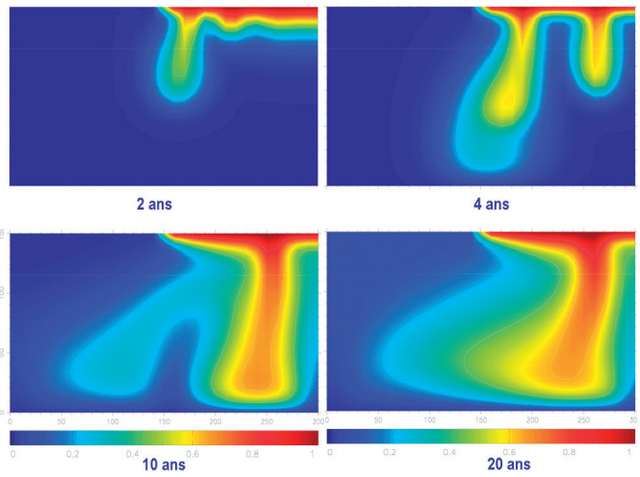
IMAGE OF RESEARCH

SALT WATER INVASIONS OF WATER TABLES

The contamination of water tables by salt water may be caused by overpumping an aquifer located close to the sea, which creates conditions that are propitious to sea water entering the water table. In order to prevent this type of contamination, researchers on the Sage team are modeling and simulating underground flows and movements of salt water. This approach is based on the coupling of models, those for currents and those for variations in salt content, and on their digital analysis.

The photo shows the evolution over time of the salt concentration in an aquifer based on Elder's test. A layer of salt on the upper side of the water table disperses due to molecular diffusion and under the effect of gravity, caused by a difference in density between fresh water and salt water. This dispersion produces a current that, in turn, carries in salt. One can see semblances of fingers, which are characteristic of the physics involved. This work was carried out by the Sage team, INRIA Rennes—Atlantique, as part of the Hydrogrid project (cf. also, *Inédit* No. 50).



© INRIA / Équipe Sage / projet Hydrogrid

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signed a special agreement on technology transfer with these two innovation promoters for which we took the initiative. The goal is to promote relationships between public research institutions and innovative SMBs, especially considering the contracting procedures required for this type of transfer.

Lastly, we are about to open a club for our partner SMBs with the aim of strengthening our ties with them. This will mainly involve providing information likely to be of interest to them, whether in terms of the job market or access to information on potential means of collaboration and opportunities for technology transfer.

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Competitiveness centers, a way to reach SMBs

INRIA is making more global investments in the competitiveness centers in an effort to enhance its technology transfer activities with SMBs. The Minalogic center in Grenoble is a good example of this. It is based on the unusual combination of micro-nanotechnology with embedded intelligent systems software.

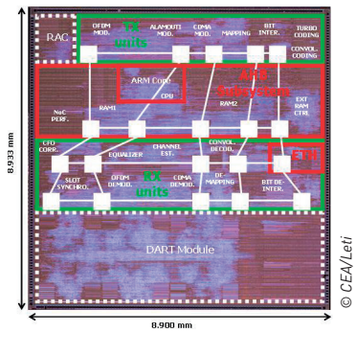
The goal of the Minalogic world competitiveness center is to shift the competitive battlefield from that of production costs to speed of innovation, and to become the top European center, as well as one of the world's most prominent, for intelligent systems micro chips. It possesses strong advantages in doing so, since it rubs shoulders with a cutting-edge research environment and since leading industries in that field, such as HP, Bull and STMicroelectronics, are present in Grenoble. *"Minalogic comprises 23 major corporations, 74 SMBs and 13 research and training centers, not to overlook the local institutions, R&D firms and venture capitalists who are also members of the center,"* adds Philippe Broun, manager for partnerships and innovative projects at INRIA's Grenoble center. *"Fifteen teams from the Institute are participating in Minalogic's projects, and one of them, in which INRIA and one of its recent start-ups (MilPix) are partners with an SMB in Grenoble, will soon receive a label."* The Grenoble research center teams are participating in research on the *"software and chip-embedded intelligent systems"* aspects such as the Multival project for multi-processor platforms (cf. box on *"Validating multi-processor architectures"*) and the Iglance project on 3D television that also involves the INRIA start-up 4DViews. As another example, Institute teams are participating in the Aravis project on architectures for embedded high-performance computing systems. This project was awarded the center's green label, given to projects that serve to reduce or control energy usage. The Institute is also becoming more and more involved in projects related to the cluster's micro and nano technologies. A superb example of this is the Minimage project, focused on microelectronics and optics, which will help create an international outlet for the micro camera in Europe by means of leaders of industry, SMBs and public laboratories (cf. box *"Tomorrow's micro cameras"*).

Run by their corporate sponsors and integrating a number of innovative SMBs, the competitiveness centers are, for the Institute, a key component of its strategy for technology transfer to SMBs (cf. article, Page 1). *"They bring up the key innovation problems for a given industrial process and enable us to maintain contact with the SMBs that we are not very familiar with and for which we should be able to identify their needs in order to set up favorable conditions for transfers,"* explains David Monteau, manager for competitiveness center relations in the Department of Technology Transfer and Innovation. Participation in the centers allows INRIA to benefit from, and contribute to, a defining collective effort in developing innovations.

At Minalogic, the new national sector representatives hired by INRIA are already taking steps to identify innovative SMBs and put them in contact with INRIA research teams. *"These people are working, for example, with the team at the Minalogic center, especially its SMB manager, in coordination with the industrial relations department at INRIA Grenoble,"* notes David Monteau. This work should be facilitated by the fact that Minalogic, just as INRIA, has made a commitment, through an SMB agreement, to promote innovation in SMBs. ●●●

VALIDATING MULTI-PROCESSOR ARCHITECTURES

*Started on December 1, 2006, Multival is one of the first projects set up at the Minalogic center. Administered by STMicroelectronics, it also includes Bull and the CEA's LETI in working on CADP software developed by the Vasy team at INRIA. CADP (*Construction and Analysis of Distributed Processes*) provides verification tools for asynchronous systems (cf.* Inédit, *No. 58 and No. 60). The goal of this project is to use CADP to validate new multi-processor and multicore architectures. Bull is using it to design its Fame2 architecture destined, among other things, for use in the Tera 100 petafloppy supercomputer. The CEA's LETI is using CADP to validate and co-simulate its chip-based network architectures, Faust and Magali. Lastly, STMicroelectronics is using it to verify and predict the performances of its multicore architecture, xSTream.*



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*Multival has already contributed to considerably improving and expanding CADP. "*We have benefited from access to substantial human resources and very close collaboration with industry,*" emphasizes Hubert Garavel, manager of the Vasy team. "*Following the engineers from Bull, it is now the turn of those from STMicroelectronics working on Multival to be guests at INRIA's Grenoble center. We thus collaborate on a daily basis. Our industry partners are heavily involved and want to include CADP in the development of their architectures.*" This goal would seem to be coming to fruition through the setting up by STMicroelectronics of regular seminars on this technology and of license transfer agreements. Half-way there and it's already a great success!*

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The competitiveness centers thus become an effective springboard for the blossoming of the Institute's technology transfer strategy. In this context, INRIA is also participating in management of the centers and making efforts to stimulate the creation of SMB networks by holding thematic events with industrial partners, for example.■

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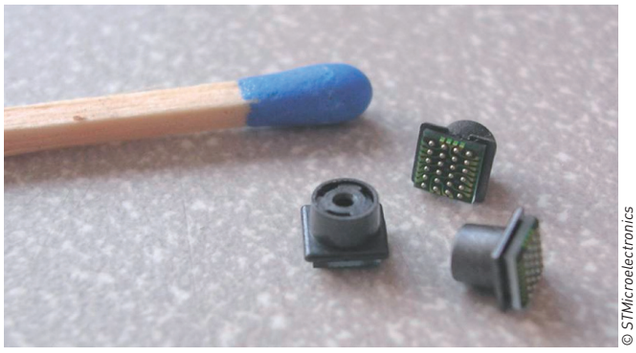

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TOMORROW'S MICRO CAMERAS

The micro cameras presently included in mobile phones have, for example, made tremendous progress in terms of size, energy use and cost, but their processing capabilities are still limited. In terms of resolution, they possess a fixed focus-length lens or an auto focus mechanism, a minimal pixel capacity and do not include processing systems. The next generation of micro cameras is under development in the Minimage project at the Minalogic competitiveness center and promises a number of surprises! This project comprises researchers from INRIA's Prima team, from the University of Saint-Etienne, and from the CEA's LIST and LETI (the Software-intensive systems and the Electronics and Information Technology Laboratories of the French Atomic Energy Commission), as well as the industrial corporations STMicroelectronics, Saint-Gobain, Varioptic and DxO. It seeks to develop by 2010 micro cameras with auto focus and images with up to 12 million pixels and software that will allow one to reconstruct a photo, analyze *it and process it as a way to provide services. All on a chip-based multicore processor with a production cost of only a few euros! INRIA's researchers are participating in the part devoted to the software. This new generation of cameras is, in fact, based on innovations that have revolutionized embedded software over the past five years and for which Institute teams, including Prima, are at the top of the line. "*We have developed a computing algorithm, known as "pyramid", that allows one to substantially reduce the complexity of computing functions without that involving approximations. One can thus execute image descriptions or sequences of robust, rapid and invariable images,*" explains James Crowley, manager for the Prima team. This algorithm allows one to envision including highly sophisticated applications in embedded objects. For example, a camera in a mobile phone could be used to detect and extract faces from a very wide field and provide a standardized image for a handheld visual phone. The user would also be able to scan an image or a text by moving his phone across it and the software would reproduce that image or text by assembling the series of images collected (image stitching)! "*Tests we have run on face detection show that this solution is faster than that of our competitors while still using a lot less memory,*" adds James Crowley. This is an advantage that our industrial partners will not hesitate to put to good use.*

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START-UP

HOW TO MONITOR CHANGES IN THE DEVELOPMENT OF SOFTWARE?

Software publishers and computer services companies are constantly on the lookout for ways to improve their development processes. This need has grown with the increase in complexity of component-based software and the spread of community-based development. A new program for supporting development activities will soon be available thanks to the code analysis technology developed by INRIA in collaboration with Paris Diderot University.

Existing programs are all too often content to measure the activity involved in developing a software in terms of the number of lines of code produced, added or subtracted. The Antelink technology goes beyond this by allowing one to analyze the production processes that lead to the creation of a new version of a program. It offers the advantage of being more robust, due mainly to a representation of the highest level program, which takes into account objects having a "meaning". In order to better market its technology, the future company Antelink launched into a long maturing process of nearly two years before setting up the company. It was thus able to test the validity of its concepts, carefully identify needs and develop pre-production prototypes with industrial partners and potential customers. Tests were run using real data at the Ilog publisher and on the corpus of free software at INRIA in order to measure the extent to which the teams re-used code bases. At the same time, Antelink was able to refine its financial model. This work is now bearing fruit in the form of a Web platform, accessible by INRIA staff, which displays the results obtained for its open source projects. Under incubation at Agoranov and being assisted by INRIA Transfer, Antelink is a good candidate for the Oséo competition (in the creation-development category) and will see the light of day as a full-fledged company in 2009.■

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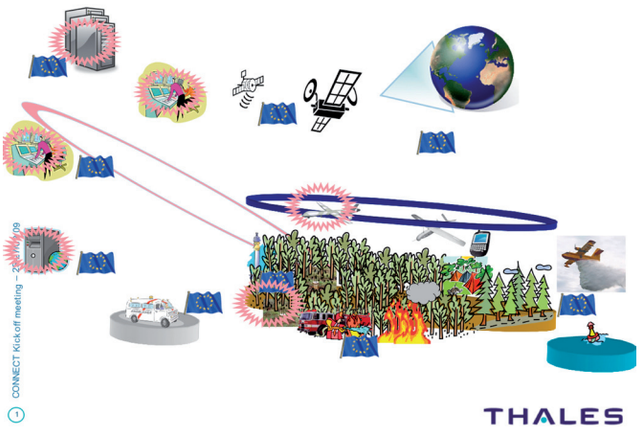
Unconditional interoperability

Connect, administered by INRIA, is a European project that is part of the* Future and Emerging Technologies *(FET) program of the 7th FP. In these terms, it has an extremely ambitious goal: to design a system that enables systems to be interoperable without prior knowledge of their interaction protocols!



Interoperability is the capacity of systems to interact despite their substantial heterogeneity. It is currently achieved by designing standards that, if rigorously followed, allow all digital equipment to exchange data. This approach is, however, most often specific to a particular field of application and is necessarily destined to be overcome by the creation of more efficient new products and standards.

The direction taken by the European Connect project is visionary from this point of view: it goes beyond the notion of norms or standards to create a system able to automatically adapt to any environment whatsoever. *"We are seeking a software solution that will allow us to link heterogeneous technologies without knowing beforehand what their interactive protocols are,"* explains Valérie Issarny, coordinator of the Connect project. *"The idea is to generate, on demand, the right protocol for systems that need to communicate, what we call on-the-fly connector synthesis."* In order to reach this goal, one has to model the protocols so as to develop programs that enable reasoning about those protocols, analyzing them, translating them and generating a protocol specific to the systems involved. The knowledge bases at INRIA and the University of Aquila regarding the synthesis and generation of protocols will be in demand for this project, along with those at the University of Lancaster on interoperability aspects. Furthermore, the skills of researchers at the University of Beijing concerning adaptive middleware will be called on to be able to change the software to be executed locally.

However, since it is also a question of being able to adapt to future norms and standards, one has to identify and characterize an as yet unknown standard based on observation of how it operates. This aspect is the focus of partners from the University of Uppsala and the Technological University of Dortmund, specialized in learning techniques. Researchers at the Italian National Research Council (CNR) will, for their part, ensure that these developments provide a satisfactory level of service quality (security, reliability, etc.). Lastly, the industrial companies Docomo and Thales, who have considerable interoperability requirements given their presence in mobile or highly heterogeneous applications, are testing and evaluating the solutions proposed. For example, researchers will test their methodology on a scenario for European intervention in the event of wildfires, an application requiring the interaction of many systems from various countries that normally are not inter-connected (cf. illustration): Internet-based servers, drones or satellites to follow the spread of flames, Canadairs, sensors, etc. *"This is a long-term project,"* Valérie Issarny advises, *"but after the next three and a half years of the project, we should certainly be in a position to generate such protocols for systems of average heterogeneity."* ■

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■ A BESTSELLER ON ROBOTICS

Truly a bestseller, the *Springer Handbook of Robotics* has turned out to be Springer's top selling work in 2008 in the Engineering category. The product of seven years of continuous work, this anthology of more than 1600 pages found itself, last February—less than 5 months after its publication—the award winner of two prizes from the Association of American Research Publishers: the *Award in the Engineering & Technology Category* and the *Award for Excellence in Physical Sciences & Mathematics*. Six INRIA researchers contributed to this work, which retraces scientific advances made in the field over some fifty years, as well as their social and ethical impacts. This compilation of traditional and emerging robotics applications reveals the modernity of this field and explains the challenges to be faced, especially in the realm of personal services.

Edited by two prominent figures in robotics and collecting ●●●

the contributions of 164 authors into seven sections administered by special editors, this book constitutes an essential reference work for all researchers and students in the field, as well as in related disciplines. It is a success that attests to the Institute's renown in the fields of controls (C. Samson, P. Morin, F. Chaumette), structure analysis and modeling (B. Espiau, J.-P. Merlet) and intelligent vehicles (M. Parent).■

Springer handbook of robotics, B. Siciliano et O. Khatib (Eds), 2008, LX, 1611 p. 1375 illus., 422 in color. With DVD., ISBN: 978-3-540-23957-4

ZOOM

Fuscia, a gateway to the digital university

Interview with Patrick Rambert, Director of the Fuscia project

As part of the national digital university program, INRIA directs the Fuscia project in partnership with two university consortia, UNISCIEL and UNIT, both of which the Institute has joined. INRIA is thus the first public research institute to actively participate in this project of on-line courses for French and foreign students.

INédit *: What is Fuscia?*

Patrick Rambert: Fuscia is a project initiated by INRIA. Its objective is to improve the visibility and accessibility of pedagogical resources in the fields of Computer Science and Applied Mathematics, and to create new resources. To do so, we have joined forces with institutions specialized in education: the Digital Engineering and Technology University (UNIT) and the University of Sciences On-line (UNISCIEL), which bring together some fifty universities and elite engineering schools. We are also working in close collaboration with the Institute's multimedia and documentation departments.

Thierry Viéville directs the content committee, which holds a monthly meeting with universities from a dozen locations, mainly those specialized in e-learning, in order to select which courses to promote, which to improve and which to create.

© INRIA / Photo C. Lebedinsky

INédit *: Why has INRIA invested in this project?*

Patrick Rambert: Today's students are seeking supplementary courses the world over by surfing the Web. Being a visible part of the canvas also contributes to the attractiveness of a university or institution and, in a broader sense, to making a country's scientific and industrial ideas more widely known. If we don't invest, this niche will be taken over by others! For example, Canadian and Indian universities have a strong presence in Africa, where they offer numerous on-line resources, sometimes even translated into the local language.

More specifically, INRIA may have something to gain by publishing its research results via this channel. For example, certain proven technologies, such as the Coq program test, are ironically almost less widely taught in France than in the U.S. It is thus hard for them to break into the industrial environment that they are supposed to serve. On-line courses are a way to make these new methods known to a much greater number of students, as well as to corporate researchers and engineers as part of continuing education. Fuscia thus contributes to two of the Institute's missions: research-based training and knowledge transfer.

INédit *: What are the various services offered by Fuscia?*

Patrick Rambert : An information office was just opened a few months ago. It answers users' questions and puts them in contact with researchers working on a subject of interest to them. This service is open to everyone and is currently being used mostly by students in high school and graduate school for their personal independent study projects (TPE) and supervised individual study projects (TIPE). We are already receiving some twenty questions a month.

At a second stage, we will offer a simple and well-organized orientation to the resources to be found on the sites of universities and research institutions. Access to these courses will be facilitated and programs of study will be offered that are adapted to the audiences. This project is well under way with UNIT and will be available two months from now. However, the creation of new on-line courses is still in its pilot stage. Two such courses are currently being developed and are designed to be as interactive as possible, through a combination of multimedia elements, hypertext and on-line exercises. One covers middleware and the other, formal proofs. We plan to have them on line at the end of 2009.■

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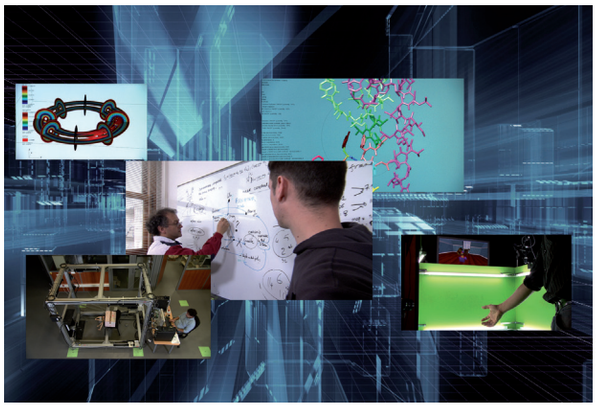
PRODUCTIONS

Our strategic plan in pictures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In 2009, INRIA will enter its second year of administration under the strategic plan for 2008-2012. This film, *Digital Challenges*, retraces in fine detail the priorities set forth in that report through a palette of images showing researchers at work in their laboratories. Our intention in filming their accomplishments is to highlight the four priority areas established by the Institute: modeling, programming, communicating and interacting. From the little robot dog, Aïbo, to the cybercar, by way of assisted mobility for people and the development of a digital cell model opening the doors to nanotechnology, the ICST are present both at a daily level and in all of our fields of research. The second part of the film deals with the three applied fields to which INRIA is, in fact, devoting considerable attention: digital engineering, the digital sciences and digital medicine. The last sections of the film sum up on their own the Institute's philosophy: *"It is by means of a strategic vision tied to these priorities, and by research programs with teams producing new knowledge, technologies and innovation that we will overcome the digital challenges of tomorrow."*

http://videotheque.inria.fr/

BOOKS

The Automotive Embedded Systems Handbook

N. Navet and F.Simonot-Lion

CRC Press, Taylor & Francis Group, 2008, ISBN: 9780849380266

The Automotive Embedded Systems Handbook provides a comprehensive overview of existing and future automotive electronic systems. It presents state-of-the-art methodological and technical solutions in the areas of in-vehicle architectures, multi-partners development processes, software engineering methods, embedded communications, and safety and dependability assessment. It serves as a reliable, complete and well-documented source of information on automotive embedded systems.

Stephan Merz is a member and Françoise Simonot-Lion is the scientist leader of Trio project-team, INRIA Nancy – Grand Est.

Observation and Control for Operator Semigroups

M. Tucsnak, G. Weiss

Springer, Series: Birkhäuser Advanced Texts / Basler Lehrbücher , 2009, XI, 483 p., ISBN: 978-3-7643-8993-2

This book studies observation and control operators for linear systems where the free evolution of the state can be described by an operator semigroup in a Hilbert space. The emphasis is on well-posedness, observability and controllability properties. The abstract results are supported by a large number of examples coming mostly from the theory of partial differential equations.

Marius Tucsnak is the scientific leader of the Corida project-team, INRIA Nancy – Grand Est.

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