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Inventors for the digital world

Our society relies increasingly on digital technologies to communicate, seek medical information, travel, or have fun. These often-invisible technologies simplify our tasks and enrich our daily lives, while also developing the economy.

At the interface of computer science and mathematics, from pure research to technological development and to industrial transfer, researchers at Inria, a public research institute, are inventing tomorrow’s digital technologies. Inria’s research is collaborative, which is evidenced by the diversity of the talent comprising its research teams, as well as in the many joint projects conducted with public and private research entities in France and abroad.

While competing with the leading international specialists in their field, Inria researchers and staff are also committed to sharing their knowledge with the widest possible audience.
DIGITAL PRIVACY

“The part that IT plays in our daily environment is undeniably a source of progress… but one which could quickly turn into a nightmare if we do not take care to protect everyone’s privacy.”

Claude Castelluccia, senior research scientist, Planète project-team, Grenoble – Rhône-Alpes research centre

The Planète team’s research objective is to analyse existing software and digital services, such as social networks and smartphones. In a world where everything is connected… and traceable, this work aims to develop new solutions to protect users’ privacy, whilst still maintaining optimal service quality.
“Bringing a bit of semantics into a world of links will lead to better management of the data posted and viewed on the internet, and make it easier to search and use it. The purpose of my work is to give internet users the means to control their presence on the Web.”

Fabien Gandon, Edelweiss project-team, Sophia Antipolis – Méditerranée research centre

The Edelweiss team’s research is devoted to reasoning in relation to the growing mass of online data. The researchers look at metadata, i.e. data that characterise other data in order to sort them and assess their pertinence. Having control over metadata means being able, in future, to have control over the Web.
“Mathematics lets you see the invisible. Our project involves providing a precise mapping of the subsoil, in order to optimise the exploitation of fossil energy sources (petroleum, gas). We are also looking to model destructive geophysical phenomena to determine high-risk zones and thereby be able to protect local populations.”

Hélène Barucq,
Magique-3D project-team leader, Bordeaux – Sud-Ouest research centre
The Magique-3D team works on seismic imaging and computing for seismological purposes. It develops digital methods to collect, process and aggregate large amounts of information. It builds complex models and makes use of high-performance computing resources in order to apply them to geophysical studies.
HEALTHCARE

“Healthcare

“Depression is a major public healthcare issue. Through my work, I seek to improve nerve stimulation treatment response. The solutions we’ve developed help to treat a large number of patients every day at Rennes hospital.”

Pierre Hellier,
research scientist in the Serpico project-team,
Rennes – Bretagne-Atlantique research centre.
It was in the Visages project-team that Pierre Hellier contributed to the concept of a neuronavigation system.

The Visages team developed a neuronavigation device, a veritable “brain GPS,” that is used to guide medical and surgical procedures in real time in a simple, precise way. This image-processing control system is used in transcranial magnetic stimulation, a treatment for depression.
The Demar team strives to improve electrical stimulation methods, i.e. the skillfully calculated application of electrical currents that trigger coordinated muscle contractions in the paralysed limbs. To obtain functional movement (walking, posture, prehension), it is necessary to control the activities of all the muscles involved: those of healthy as well as disabled limbs.

“Central nervous system injuries can cause paralysis in certain limbs even if the muscles are intact. In my work, I aim to assist or restore functional movement in paralysed limbs using their residual motor abilities, particularly in cases of hemiplegia and paraplegia.”

Christine Azevedo Coste, researcher in the Demar project-team, Sophia Antipolis – Méditerranée research centre
INVENT TO SERVE
In a digital age, Inria is ready, now more than ever, to handle all of its missions: facing new scientific challenges, developing relations with the economic and industrial world, participating in major societal projects and raising public awareness of digital sciences. Inria has proven its capacity to evolve, demonstrating its scientific agility and solid foundations, in a constantly changing French research environment. Michel Cosnard, Chairman and CEO of Inria, and Antoine Petit, Deputy Managing Director, share their views.

In a period marked by continuous upheavals, for society in general and in the world of research, how can the Institute ensure and maintain its vibrancy?

Michel Cosnard: Since the world and society are becoming more digital, the need for research and innovation in our scientific fields is constantly growing. New research themes are emerging, linked to our traditional skills, at the crossroads of informatics and mathematics. They are more systematically linked to societal challenges like the environment and health, the internet of the future (sensor networks, social networks...), security and reliability of software programmes or privacy issues. In this
particularly stimulating context and in order to respond to new problems, Inria researchers are launching new projects, looking for new partners and forming new teams.

**Antoine Petit:** For all these challenges, competition is global. Indeed, beyond their cognitive aspects, digital technologies are considered, and rightly so, as a key factor in economic and social development, thanks to their capacity for innovation and disseminating technology. Our ambition is clearly to continue working within the exclusive circle of leading research institutes that are an international reference in digital sciences.

**How has Inria been able to grow and control its development?**

**M. C.:** Above all, there are the fundamentals that characterise our work. The first is the nature of our research teams: our teams are small and work on projects with strong societal or economic implications. The second concerns our eight research centres, which all have, working alongside researchers, departments dedicated to development and support for research. This is an important asset. Finally, the national character of our institute translates into the definition of strategic national schemes, implemented in a transdisciplinary manner by our scientific and functional departments. Our organisation does not have a rigid hierarchy. It is capable of rapidly evolving to tackle new subjects in different fields, thus ensuring great agility. This is true for our research teams, but also for our different business lines, which regularly demonstrate their ability to adapt.

**A. P.:** Inria’s flexible organisation allows it to respond effectively to a certain number of current scientific and organisational challenges. Thanks to our responsive project-teams, and their appeal, we can focus our efforts on new projects and attract talents from around the world. For example, Inria mobilised its resources in the context of the Future Investments programme. The
purpose for Inria was to confirm its role as a national player in transfer and innovation - as can be witnessed in our Institut Carnot certification - to cultivate new partnerships in life sciences, the environment and medicine, and to consolidate its influence in a digital economy.

What are some major projects in the future that will help Inria confirm its position and ensure its missions?

A. P.: Inria has a long tradition of working with the industrial and economic world, for which it is a privileged partner in digital technologies. We are going to pursue this policy, by focusing our efforts on SME. Moreover, we intend to develop our relations with the public at large, in order to answer questions our fellow citizens have about digital technologies and their role in society. As a national institute, Inria also intends to continue being a key player in European research policies and contribute to constructing the European research area.

M. C.: In ten years the Institute has doubled in terms of size and budget. Now our goal is to consolidate our organisation, assert our national presence, multiply our partnerships with French and European universities and reinforce our complementary role with the CNRS. Therefore, our research centres, which are strongly embedded in their regional environments, should play a major role in elaborating and building territorial strategies for excellence in digital sciences, in partnership with all the players concerned. Thus, they will contribute to creating the strong and highly visible regional clusters France needs. To sum up and conclude, today we are equipped to face the scientific, social and economic challenges of the next decade, in which digital technologies will play a major role.
A new organisation for a new way of working

More modern management, clearer relations with other institutes, focusing of investments on fledgling centres, rolling out of the Allistene alliance, an increase in its own resources: Inria has consolidated its organisation and ensured the longevity of its way of working in a changing research environment.

“2010 has been devoted to a lot of work in order to prepare for the future,” concludes Hervé Mathieu, Chief Executive Officer for Resources and Service Administration. “We had to adapt to new rules and a new development model promoted by the State. A lot of projects were conducted, including some that will essentially be completed in 2011.” The goal is to prepare the institute for new challenges: reorganisation of the world of research, new scientific challenges related to societal issues, adaptation to changes in how organisations are funded and the development of new tools.

A complete reorganisation of management methods and procedures

Projects dedicated to modernising management were launched in 2009 and led to certification of the institute’s accounts in 2010. This regulatory obligation required a great deal of work and a complete review of financial procedures, which, after examination by the statutory auditor, only gave rise to a small number of reservations. At the same time, reorganisation of IT means and a necessary update of the institute’s internal information system progressed significantly and will continue in 2011. This

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framework agreements signed with partners in higher education and research since 2009.
phase, devoted to harmonising practices and sharing data, represents an inestimable move forward in managing the institute. It will make managing research projects easier, for example in the context of European contracts or the ANR.

Positive growth, focused on new centres
The new model for organising research that is taking shape has been accompanied by a stabilisation in State funding: “Our growth is now supported by our own resources,” points out Hervé Mathieu. “They have been highly significant this year, with an overall increase of 47% and growth of 28% for revenues linked to research contracts. This has allowed an increase of our means, in constant euros, of more than 11% in 2010.” Therefore, despite a decline in the number of openings for civil servants, recruitment levels have remained high. Investment efforts have been concentrated on three recent centres in Bordeaux, Lille and Saclay, whose basic means have not been completely established and who have pressing needs in terms of infrastructure.

A successful transition into the future
Inria has aligned itself with the new national strategy in research and innovation (SNRI) adopted in July 2009 and which is organised around universities. In particular, a framework agreement was signed in December 2009 with the Conference of University Chancellors (CPU). “In 2010, we set up, within the context of the Allistene alliance, a common environment for working with universities and schools as well as the CNRS (French National Centre for Scientific Research) and the CEA (French Atomic Energy Commission) in
computational sciences and technologies,” says Hervé Mathieu. Coordination with the CNRS led, in 2011, to the signature of a framework agreement with the latter, clarifying, in particular, the organisation of partnerships set up by both institutions with universities, either within joint research units (UMR) or joint project-teams (EPC).

The Allistene alliance should help identify common scientific and technological priorities among its members in order to reinforce partnerships and create links with businesses. “The alliance’s structure has been defined this year, with the creation of a coordination committee chaired by Michel Cosnard, five interdisciplinary task forces and six policy groups that are now up and running,” explains Claude Kirchner, Executive Officer for Research and Technology Transfer for Innovation. “An agreement has also been signed with the ANR in order to specify how the two entities are going to establish a joint programme, taking into account the major challenges in the field. Furthermore, the Allistene coordination committee has voted in favour of setting up an ethics committee in computational sciences.”

Finally, systems to support the creation of new firms have been reorganised to increase efficiency and integrate more easily the common strategy of actors within the alliance. Thus, Inria-Transfert has been replaced by three firms: Inria Participation (a 100% subsidiary of Inria), which covers all Inria interests in firms, IT-Translation (IT2), which supports entrepreneurs, and IT2I, a venture capital fund set up in partnership with a state-owned bank, the CDC (Caisse des Dépôts et de Consignation), which will inject funds into start-ups.

Organising science in order to be more efficient and responsive
Consolidated in 2010, the new organisation of Inria’s research activities is designed to maintain its efficiency and responsiveness, even though its research teams have doubled over the last decade. Research activities are organised according to five major fields, each led by a Deputy Scientific Director (DSA). This system allows them to work closely with researchers and coordinate their activities more effectively, notably in terms of collective responses to
calls for projects. “The DSA provides scientific leadership in his field and acts as coordinator who is very close to both teams and researchers,” emphasises Pascal Guitton, Director of research department. “They must also contribute to implementing Inria’s national scientific policy and help shape collective visions in order to synchronise the work that needs to be done over the next five years. Finally, they must help identify new research themes that the institute should get involved in.”

In this context, “exploratory” incentive actions allow the institute to consider new hypotheses that break with conventional thinking, before creating a team on a topic, if it indeed turns out to be promising. These initiatives are scientifically risky and therefore limited in number. On the other hand, the number of large-scale initiatives, which involve Inria teams and external partners over a 4-year period in the study of complex issues, are destined to increase. “Indeed, these initiatives tackle very difficult problems that a single team could not easily solve and therefore necessarily involve several players,” explains Pascal Guitton. “Inria wants to engage in more of these projects because they represent current scientific challenges in our fields of research and often involve major stakes for society such as health, energy or the environment.” Two large-scale initiatives have been created this year, raising the total number to seven.

**Major tools to organise software development**

An essential step for innovative research is also the possibility of experimenting with algorithms and software on technological platforms. Providing
invaluable support for research teams, experimentation and development departments have also been deployed and organised in 2010. Inria has also invested, with institutional partners and local authorities, in high-tech facilities. In Lille, the institute inaugurated the Inria Euratechnologies platform, a place for exchanges and collaborative work open to Inria researchers and partners. It is home, in particular, to the Lille node of a network experimentation platform (Senslab) deployed on sites in Lille, Grenoble, Rennes and Strasbourg. In Nancy, the high-security computing laboratory has opened its doors. It is used to conduct experiments by Inria and its partners in network security, exchanges and telecommunications equipment. Finally, a virtual reality room has been inaugurated at the Sophia Antipolis-Méditerranée Research Centre (see following p.18-19). It will be open to regional or European academic and industrial partners.

Promoting home support and independence of the elderly or disabled is the objective of a large-scale initiative called PAL (Personally Assisted Living). This scientific and technical challenge involves a wide range of skills: 9 teams from 4 of the institute’s centres and a host of partners, including the CSTB (Centre Scientifique et Technique du Bâtiment) and the Nice CHU (teaching hospital). They are organised around a dedicated infrastructure where they can combine and experiment with innovations in robotics, sensors and cognitive methods to prevent falls, detect signs of malnutrition, improve mobility or preserve social ties.
HIGH-SECURITY LABORATORY (LHS), Nancy – Grand Est centre. Computing and telescope clusters for collecting and studying IT threats. Wadie Guizani, engineer in the Carte team.
IMMERSIVE ENVIRONMENT FOR TREATING DOG PHOBIA

The immersive cube consists of three vertical screens and a horizontal screen. The purpose of the system is to obtain a real immersion sensation for a single user. The cube is one of the components of the Gouraud-Phong room, an immersive space of variable dimensions at Inria Sophia Antipolis – Méditerranée.
More structured and ambitious partnerships

Now more than ever, Inria’s work is part of a national project open to Europe and the world. Defining means of cooperation and agreeing on common research themes is essential for creating partnerships more easily and achieving a higher level of performance. Work on ambitious projects that the institute started in 2009 is starting to produce results.

“Preparing for the future concerns all of our relations with academic and industrial partners,” underlines Claude Kirchner, Executive Officer for Innovation Research and Technology Transfer. “These relations are destined to grow stronger. They should be more ambitious and more thoroughly developed so that we can control transfer better and thus contribute to creating wealth. They must be organised in order to achieve greater performance and legibility.” This is the challenge Inria intends to take up by reinforcing the high-quality relations it has cultivated with research teams and industrialists. This approach is deployed on national, European and international levels.

A partnership for the environment and sustainable development

On 8 September 2010, Inria and the Cemagref signed a partnership agreement reinforcing their collaborative work on environmental issues and current challenges raised by global climate change and sustainable development. In fact, concerning the environment, as in many other disciplines

40%

In 2010, funding through bilateral industrial agreements increased by 40%.
To this end, Inria set up, in 2008, strategic bilateral agreements that contribute to organising the institute’s skills around major industrial challenges. These partnerships are based on ambitious common research programmes, for periods of 4 to 5 years, focused on themes that are important for industry such as simulation and high-performance computing for EDF, self-organised networks for Alcatel or security for Microsoft. A framework agreement defines the conditions of this work in terms of intellectual property rights, management or publication issues. “The objective is to promote quality partnerships that allow Inria researchers to confirm their ideas and software in real life application scenarios provided by the industrialist,” explains Olivier Trébucq, Head of Strategic Partnerships and Key Accounts. “As for the firm, it benefits from a high level of expertise on important questions. It gains a long term vision that allows it to identify challenges or potentially interesting subjects for its business in the future.”

The first of these strategic partnerships was signed with Alcatel-Lucent and has led to the creation of an open laboratory that will celebrate its 3rd anniversary in 2010. “Around a dozen patent applications have been submitted jointly, based on three major research initiatives undertaken in 2008, and projects with third parties have been launched, notably within the 7th Framework Programme for Research and Development,” emphasises Olivier Trébucq. “It’s a wonderful illustration of the high level of skill and emulation that exists within the laboratory!” A real community of expertise has been established around key issues for the internet of the future.

New agreements around strong socio-economic challenges
Three new framework agreements were finalised in 2010, raising the total number of strategic partnerships signed to 9. The first one, signed with Bull, led to the selection of five projects on themes defined with the firm. These projects mobilise a dozen Inria teams and concern parallel programming environments, optimisation of energy consumption or the resilience and fault-tolerance of tomorrow’s computers. The second agreement, with the ANDRA (French national radioactive waste management agency), involves six Inria teams in research on modeling and simulation of physical and chemical processes that affect buried radioactive waste throughout its existence. For the ANDRA, this partnership contributes, among other things, to optimising the use of computation codes, which are increasingly cumbersome, and managing ever-increasing amounts of data.

The third agreement, signed with EDF, defines the terms of a partnership concerning high-performance computing and simulations for energy. 12 Inria project-teams work with 6 R&D departments at EDF to develop tools for visualising large volumes of data or programming models for hybrid multi-core architectures.

Three start-ups created thanks to Inria research (Distene, Sysfera and Caps entreprise) are also involved in the design of these research initiatives.
involving complex problems, researchers need to rely on computational sciences. Modelling and simulation, observation and detection techniques, managing huge amounts of data, etc. are at the heart of Inria’s work and its commitment to serving other disciplines.

Creating a European network to reinforce innovation

Today Inria is deeply involved in the major European alliance EIT ICT Labs and coordinates French initiatives. This Knowledge and Innovation Community (KIC) must reinforce synergies between research, training and innovation to support European industry in services and applications linked to the information society. This is a crucial sector for European economies. 2010 was devoted to organising this highly ambitious programme and its deployment on 5 sites (Berlin, Eindhoven, Helsinki, Paris and Stockholm) involving 21 main partners, including 8 industrialists, 6 research organisations and 7 leading universities, as well as innovation centres and competitiveness clusters. Since September 2010, the community has had a CEO, Willem Jonker, and a “co-located” system of governance involving the 5 centres. “In 2010 we created tools to encourage exploitation and transfer of research results,” explains Bruno Le Dantec, head of the French “node”. A European entrepreneur’s club now provides a point of access for national firms interested in doing business in other member countries. At the same time, the Technology transfer program will facilitate the transfer of research results to industrialists and SME on a European scale. “This tool will greatly improve use and dissemination of research results,” according to Bruno Le Dantec. “The European project Contrail in the field of cloud computing has benefitted from support that has allowed it to confirm its results on European test benches, before disseminating them widely among partners and European students through workshops and a summer school session.”
Research and training throughout Europe

At the same time, research activities based on the themes of EIT ICT Labs have been set up. “The French part coordinates the theme Tomorrow’s digital city,” indicates Bruno Le Dantec. “It involves imagining services that will make life easier for urban residents and integrating work conducted on other themes (Health and wellness, Energy efficiency...). We have obtained permission from the mayors of major cities covered by the 5 nodes to carry out experiments in situ.”

Concerning training, 7 European Masters have been created and will be taught in partner universities, in English, starting in 2012, thus encouraging the mobility of both students and professors. The French participate in three Masters: internet technology and architectures, Distributed systems and services and Human computer interaction and design.

Consolidating partnerships with North America

Organisation and legibility are also the watchwords of Inria’s policy concerning international relations. Created in 2009, the JLPC (Joint Laboratory on Petascale Computing), a joint laboratory with the National center for Supercomputing Application at the University of Illinois (USA) has led to highly productive collaborative projects.

This has allowed French researchers to take part in a major American project, the Blue Waters Petaflop Computer, and to contribute to the design of software for the optimal operation of this supercomputer. 10 articles and 5 software programmes have already been produced. Thanks to this high-quality contribution, the JLPC now coordinates an international research programme on climate simulations based on high-performance computing,
initiated by the G8 and involving partners from the United States, Canada, Germany, Japan, Spain and France. Other collaborative work with American researchers should be more visible. “Around thirty of our teams have created ties with researchers at Berkeley and Stanford, which are among the leading universities in Inria’s fields of expertise,” notes Hélène Kirchner, Director of International Relations. “We would like to reinforce these relations and highlight them more.” This goal was formalised in 2010 with the signature of an agreement with the Citris (Center for Information Technology Research in the Interest of Society) in order to organise existing collaborative work within a common project called Inria@Silicon Valley.

**Consolidating federal and national agreements**

Another project designed to formalise scattered collaborative projects has started in Brazil. Inria has had long-standing relations with Brazilian researchers and co-funds exchanges between teams. “Inria would like to reinforce, organise and consolidate relations with different Brazilian states in order to assert its presence in this vibrant and promising country,” underlines Hélène Kirchner. A cooperation agreement signed with 11 federal research agencies and their coordination within a national confederation has enabled the launch, in 2010, of a joint call for projects on behalf of all these states. Sixteen Franco-Brazilian projects have already been submitted.
Since its creation, the mission of Inria has been to ensure the transfer of knowledge and technologies developed by its teams to industry. Its purpose? Making sure its work in R&D is transformed into products and services, contributing to the creation of economic value. Currently SMEs are the institute’s privileged partners in this joint effort to promote innovation.

Sharing expertise, knowledge and new technologies with businesses is one of the missions the State has assigned the institute. This means, on the one hand, transferring knowledge through strategic partnerships with large industrial corporations, as described above. More broadly speaking, this also means transforming technologies developed through research into products and services launched on the market. This requires adaptations. To this end, Inria has set up a specific offer for SMEs in order to create new partnerships. In 2010 the institute also created an internal programme to support scientists conducting technology transfer projects. “To deliberately speed-up and energise this transfer we joined forces in 2010 with OSEO, a French organisation that supports innovative SMEs,” underlines David Monteau, Deputy Director of Transfer and Innovation. “The purpose of this association is to offer SMEs greater visibility concerning public research in our field. This also allows us to identify innovative sectors with strong potential for growth and levers for intensifying transfer of technologies in these sectors.”
LYATISS,
INRIA’S 100th START-UP

Pascale Vicat-Blanc, Research director at Inria

Research director at the Inria, currently on a leave of absence, for ten years Pascale Vicat-Blanc led teams specialised in support networks for internet applications, grids or clouds, which are very demanding in terms of speed and delivery. “As early as 2005, I had the idea of a new model for the internet, a model that is called ‘Cloud 2.0’ today,” she confides. “I started several projects in France and internationally and then, in 2009, I decided to formalise the deployment of this approach, with the help of a small group of doctoral students who believed in the concept. With one of them, who won the Marconi Young Scholar prize, I created LYaTiss.”

This start-up was the first to propose a platform focused on the network, enabling the deployment and optimisation of dynamic computing and communication infrastructures, and maximal performance and agility of externalised applications. “Internet users often evolve faster than research and put pressure on firms,” she explains. “Thanks to our software, firms can effectively adapt their online service offer and remain competitive.”

Speeding up transfers to SMEs

The OSEO-Inria partnership provides SMEs with a better understanding of the skills and technologies developed by public research facilities and the opportunities for development they offer. In 2010 Inria has multiplied opportunities for encounters between researchers and business. Four one-day national “Inria-Industry Meetings” were organised on specific themes (aeronautics, e-health, sustainable cities), combining technological demonstrations and forward-looking workshops in order to highlight the expectations of both parties. Other, more numerous and targeted, encounters are organised in research centres, often leading to promising collaborative projects. Above all the OSEO-Inria partnership has allowed two large-scale initiatives in favour of innovation to be set up. The first, the Mobile Service Initiative, brings together a host of players in telephony and mobile services. The second, the HPC-SME Initiative, organised with the GENCI (Grand Equipement National de Calcul Intensif), facilitates access to high-performance computing for SMEs, thanks to an expertise and support programme.

Economic models for disruptive technologies

OSEO contributes its expertise to a programme designed to monitor transfer initiatives. “In general we do not know, a priori, the right path for a technology to enter the market. The programme helps us provide support for researchers who are involved in this process and to help them financially,” explains Bruno Sportisse, Director of Transfer and Innovation. Within this programme, professionals
help researchers design their transfer project by taking into consideration, in addition to technological aspects, economic and managerial concerns. The programme also relies on a committee of external experts that studies the projects and makes recommendations. “Transfer is a long and complex process: the production cycle for a research prototype can take anywhere from a few months to several decades.” Situations can therefore vary a great deal. The committee of experts indicates the most relevant means of transfer (partnership, start-up or direct transfer) and provides information on the economic environment in which the project promoters will be working. Their common goal: making sure new products and services meet societal demands and that the corresponding economic models are sustainable and totally independent from the Inria. “To achieve this, adds Luc Grateau, we often need to suggest rather radical changes in position... encouraging the project promoters to abandon a strictly technological vision of functions in favour of a vision conditioned by demand, uses or regulations.” In 2010, 39 projects entered the programme and 11 were transformed into start-ups and 2 became I-Labs, which are light-weight laboratory organisations associating SMEs and Inria project-teams.

Opening and sharing expertise in transfers
Finally, the programme for monitoring transfer initiatives can detect work that should be exploited and decide to support it. This is the case for the work of the Aviz team at Saclay on interactive visualisation of data. “Our work involves technologies that French engineers do not master,” says Jean-Daniel Fekete, head of the Aviz team. “In order for these to be transferred, they must be a certain level of industrial quality upstream. This is a specific model Inria decided to support, by allowing the Aviz to recruit an engineer for one year. His assignment will be to rewrite our most popular systems so that they reach this level of industrial quality.” Entirely dedicated to digital sciences, today the institute has recognised expertise in the transfer of software technologies. In order to propose this expertise and...
open its systems to university partners, who are often generalists, the institute signed agreements with a dozen university clusters in 2010. On a European level, Inria has brought together research institutions recognised for the quality of their transfer activities in the software sector and currently supervises the EIT ICT-Labs Technology Transfer Program.

The dual advantage of open source software

“The open source software programmes we provide are all, first and foremost, objects of research,” underlines Stéphane Ubeda, Director of Technological Development. “They illustrate the nature of our work and demonstrate our know-how. To prove their value, we make them available to the scientific community and our industrial partners.” Open source software offers several advantages. “Making the software’s source code available forces us to achieve a certain level of quality,” indicates Stéphane Ubeda. It is above all the “open source community” that enriches the software, through a constant improvement process. “We help maintain this community, since its members use, adapt and develop open source software, adding value for everyone,” observes Stéphane Ubeda “Research is a world based on sharing: the goal is to multiply our efforts so the code remains effective.”

“The community created around open source software inherently generates transfers of technology,” adds Patrick Moreau, who is in charge of software assets. This is one of the reasons behind the creation of the IRILL (Research and Innovation on Free Software): demonstrating that transfer can take place via open source research and development. “Half of the software we disseminate is open source: afterwards, we need to be concerned with what becomes of this software. We need to make sure it survives outside our walls and that users and publishers appropriate the work produced by our researchers,” explains Patrick Moreau. From this perspective, the IRILL can serve as a catalyst.

Irill, the Initiative pour la recherche et l’innovation sur le logiciel libre (Research and Innovation on Free Software), was created in partnership with Universities of Paris 6 and 7 in October 2010.
SEEING, UNDERSTANDING, AND ACTING
At a time when masses of information are increasing at an exponential rate, visual analytics combines analysis methods with interactive visualisation methods to give the user initiative and control over the analyses in view of results that have already been calculated and visualised.
THE PLEASURE OF INVENTING
Every day, Inria researchers use their creativity, knowledge, intellectual curiosity and specific know-how to invent the digital technologies of tomorrow. Theirs is a profession that is made up of small joys and great discoveries, but also frequent self-inspection. Presenting one’s first research results with enthusiasm, imparting one’s passion by talking at conferences, facilitating exchange in the scope of an international project...

Eight Inria researchers share memorable moments from their lives as scientists.
Presenting your research is an unforgettable experience

“Explaining the result of your work before an audience of research-lecturers puts you in a thrilling situation. I experienced it during the annual congress at which the Gilles Kahn thesis prize is awarded to young researchers in computer science. It’s a real privilege to be able to talk about a subject that you’ve worked on, and to share it with an entire conference audience. But you have to find the right words to popularise the topic, keep their attention, and highlight the potential of your research. Because it’s not only a question of convincing, but also of raising interest in order to establish future collaboration. The actual fact of having to reformulate is in itself very motivating: it’s an exercise that forces you to think and look at the results of your research in a new way. An opportunity not to be missed to build your knowledge!”

XAVIER ALLAMIGEON

A graduate from the École polytechnique, Xavier Allamigeon received the Specif - Gilles Kahn award in 2010 for his work on software validation as a member of the SE/IS research team at EADS Innovation Works and the MeASI laboratory of the French Atomic Energy Commission. As a result, he has developed and made public a free-licensed tool. Recruited by Inria the same year, he joined the Maxplus project-team where he is pursuing his work.
I chose to apply my passion to research
“I’ve always loved putting my brain to work on problem-solving tasks. This character trait is the reason why I was attracted to applied mathematics. It was while I was doing my Master’s degree and then internship at Air Liquide R&D that I discovered operational research. My hobby could actually be put to professional use! I then did a Google search for words that have an important meaning for me – optimisation, probabilities, statistics, etc. – and found a PhD offer! Rather than taking a job after my Master’s degree, I decided to plunge into the world of research and work on combinatorial optimisation, which consists of finding the optimal solution for a specific problem. A lifetime of problems waiting to be solved – what more could I ask!”

MARIE-ÉLÉONORE MARMION
After obtaining a Master’s degree in applied mathematics, Marie-Éléonore Marmion is currently preparing a PhD in computer science, in the field of combinatorial optimisation. In 2008 she joined Inria’s Dolphin project-team, which works on the modeling and parallel resolution of combinatorial optimisation problems. She has already published four studies in this field.
The fruit of a passion

“The path of a researcher is marked out by opportunities that can build your career. Ever since I was in high school, I have been passionate about computer graphics. My plan was to go into the world of video games or cinema. I didn’t even know that research in the field existed. Then I met various people, one thing led to another, and eventually I ended up doing research work that was awarded the Eurographics prize, an international distinction that singles out contributions in computer graphics. Receiving a prize is of course a great pleasure, but it is really a reward for teamwork and making the right choices. A researcher explores fields without ever knowing whether they will interest anyone but himself; a prize brings the certainty that you were not on the wrong track, that your work serves a purpose. But I didn’t aim for the prize, it was simply a result of my passion!”

SYLVAIN LEFEBVRE
After a PhD thesis in computer graphics, Sylvain Lefebvre spent a year in Seattle in the Microsoft laboratories in 2005, before joining Inria. From the start, he endeavoured to optimise the computing of textures used in computer graphics. His work, which was awarded the Eurographics prize in 2010, has had a considerable impact on the academic as well as industrial world.
Striving to improve living conditions

“In September 2010, I attended a workshop on the use of new technologies to help people with reduced autonomy. This event changed the way I looked at public research missions. It prompted me not to make a complete U-turn, but to project my work towards a new purpose: providing these people with technological tools that would improve their quality of life. Applying my research to this social issue, and working with multidisciplinary teams that include researchers in computer science, psychology and cognitive sciences... the idea really appealed to me. We therefore began to set up a number of partnerships, in particular with the association Trisomie 21, the University of Bordeaux II, and the University of Quebec in Trois-Rivières (Canada).”

Émilie Balland

Émilie Balland graduated from the University of Nancy in computer science, a subject she discovered while studying for her university diploma in mathematics and computing. Her aim at the time was to become a speech therapist. Her discovery of computer science turned into a true passion. Today, she is a research scientist in the Phoenix project-team, which focuses on programming-language technology for communication services.
A memorable moment in the life of a researcher

“All researchers hope one day to obtain their Habilitation to advise doctoral theses, the highest educational qualification in France. To prepare for it, researchers must define their own scientific field of expertise and put it in perspective. This preparation includes a psychological dimension, self-inspection both on a personal and a professional level. Some researchers feel ready after five years, others after twenty; personally, it took me nine years to take the step, a time during which I assisted many PhD students. Through my contact with them, I became certain that my future would lie in my preferred field, which is 3D interaction with virtual worlds. I received the qualification in 2010, which enables me today to supervise the work of other future researchers, which is very motivating in itself.”

ANATOLE LÉCUYER

After graduating from the École Centrale in Lille, Anatole Lécuyer first started a career in engineering before returning to further studies. In 2001, he defended a thesis on tactile interaction with virtual worlds in industrial maintenance operations for aeronautics. He then joined the Bunraku project-team to focus on virtual reality.
Sharing knowledge: a mission and a pleasure

“Presenting our research work to the general public is challenging and very satisfying at the same time. I recently tried my hand at it at the Palais de la Découverte in Paris, as part of the “One researcher, one manipulation” campaign, on the topic of speaker recognition, in other words “knowing who’s talking” in a recording, based on each person’s voice signature. Choosing the right words and pace to explain a complex subject is a real challenge that requires careful thought, since the methods implemented for voice authentication rely on advanced mathematical knowledge. As for the satisfying part: that comes from the pleasure of accomplishing one of the essential tasks of a researcher, which is to give the keys to understanding and to let each person form their own opinion. In addition, the questions that the audience ask also help us to reflect on what we do.”

NANCY BERTIN
A graduate from the ParisTech Telecom engineering school, Nancy Bertin did her PhD thesis on automated music transcription. Besides her love for mathematics, she also plays the piano, the violin, and sings. She joined Inria in 2010 as part of the Metiss project-team (modeling and testing for the processing of information and sound signals).
Working on an international level is very enriching

“Before I joined Inria, I spent a year doing research at the University of Washington. That might seem commonplace nowadays, but in 1992 it was quite an unusual thing to do. Ever since, I’ve always believed that research is something to be done on an international scale, as the combination of different training and cultural backgrounds acts as a source of inspiration. From the moment I became a researcher, I’ve been involved in European projects, like Connect, which brings together ten European partners (universities, organisations and companies) to focus on issues regarding network communication. Though the coordination of international cooperation can be very time-consuming, managing teams in this kind of context is very motivating. If you have a core of people who are used to working together, it creates the necessary impetus. In the end, the effort is always thoroughly rewarded by the quality of what is exchanged.”

**VALÉRIE ISSARNY**

Valérie Issarny graduated from the University of Rennes with a PhD in computer science. She joined Inria where she manages the Arles project-team (software architectures and distributed systems) which cooperates on international projects. In 2011, her work led to the start-up of Ambientik, a company that specialises in cooperative mobile application services, of which Valérie Issarny is a cofounder.
Research driven by operational challenges

“Today, we have models that can forecast air quality, as well as a variety of new observation tools (satellites, microsensors). We have to meet the challenge of learning how to use all these information sources in the best possible way. We are fortunate in that we cover a wide spectrum, from the development of advanced mathematical methods right through to their application in the software that we design. For example, together with the company Numtech and the association Airparif, we are building a prototype that can estimate almost in real time the exposure to pollution along an itinerary that a user in Paris defines by himself on his mobile phone. This type of project allows us to match up our methods to real applications, identify new research issues, and sometimes wind up with unexpected solutions.”

VIVIEN MALLET
Vivien Mallet graduated as an engineer from the Ecole Centrale in Lyon, and obtained a PhD in applied mathematics at the École nationale des ponts et chaussées. He joined Inria in 2007 as a research scientist in the Clime project-team (modeling in environmental sciences). Among other things, he is in charge of the Polyphemus project to create a multimodel platform for atmospheric pollution and risk assessment.
INVENTING IN THE FIELD
Over the next pages, you will discover the life cycle of a project-team (with an average duration of eight years). As an illustration, we look back at the first four years of the young Magrit team, and the last four years of the Alchemy team that is about to disperse.

The Magrit project-team’s research focuses on augmented reality. Led by Marie-Odile Berger, Magrit is a joint project-team between the French National Centre for Scientific Research (CNRS) and the Universities of Nancy. Set up in 2006, its activity was extended for another four years in 2010.

The Alchemy project-team, a joint collaboration between the CNRS and the University of Paris-Sud, studies architectures, languages and compilers for high-performance embedded or general processors. After eight years of activity, notable results and the unequivocal success of its applications, the Alchemy team will now pursue its work in new projects.
Start of the Magrit project

AUGMENTED REALITY IS A NEW FIELD THAT HAS BEEN DEVELOPED CONSIDERABLY BY MAGRIT IN THE FIRST FOUR YEARS OF ITS EXISTENCE. BACKGROUND AND HIGHLIGHTS.

The history of Magrit starts in 2006 with the end of the Isa project-team (image, synthesis, analysis) that was led by Jean-Claude Paul at the Inria Nancy – Grand-Est centre. Isa at the time comprised more than 30 team members working in three distinct fields: computer vision, computer graphics, and geometric visibility. During the team’s evaluation in 2005, the creation of three new project-teams was recommended. In the Vision group, which counted five permanent researchers (two Inria researchers and three university lecturers), five PhD students, one post-doctoral researcher and one engineer, Marie-Odile Berger, an Inria researcher and university-qualified mathematics professor, decided to take the step of becoming a team manager by forming Magrit. She had been working on this topic since her thesis in 1989-1991, under the supervision of Roger Mohr.

Magrit’s goal is to develop research in augmented reality (AR), a discipline that aims to increase a person’s perception by adding information to their field of vision to improve their understanding of their environment. Marie-Odile Berger recalls one of the first highlights: “To boost our work, we supported Frédéric Sur’s application for a lecturer post. He is an expert in probabilistic methods, which is a very important part of automating the building of complex environment models.”
Alchemy: already a well structured team in 2006

The appearance of new applications and new electronic components combined with the emergence of considerable restrictions (energy saving, robustness) constantly drives the development of architecture, programming, compilation and language research. A situation experienced by the Alchemy team.

Alchemy’s history traces back to 2003. The project-team was born from the union between the A3 team that at the time counted two permanent researchers, Christine Eisenbeis and Albert Cohen, who worked on compilation, and the Architecture team run by Olivier Temam, professor at LRI. Why this merger? “We believed that most of the program performance problems in modern architectures stemmed from a lack of communication between compilation and architecture,” explains Olivier Temam, then team leader. From the start, Alchemy, which had only just been set up in Saclay, became involved in a large-scale European project that turned out to be pivotal, namely HIPEAC (European Network of Excellence on High Performance and Embedded Architecture and Compilation). “We took an active part in setting up this network with the same philosophy that prompted us to found Alchemy: bringing architecture and compilation researchers together in the fields of embedded systems and high performance. But this time, the idea was to bring them together on a European scale.”
Fundamental research on interactive modeling

Magrit aims to develop solutions for calculating insertion and visual reconstruction, two of the main challenges to be tackled to enable potential applications of augmented reality to become operational in the long run, in large spaces. At the moment, most of the applications only work in limited spaces and over short periods of time. “To integrate information at the right spot in the field of vision, regardless of the movement the user makes, the observer’s point of view must be calculated at every instant,” explains Marie-Odile Berger. “The other cornerstone is the 3D reconstruction of the environment a person sees.” Modeling is essential here, for example to take into account the interaction of light between (added) virtual and real (on the scene) objects.”

“To address these fundamental issues, we studied fully automated methods. Since 2008, we have also been studying interactive methods that let the user participate in the application. These on the one hand make it possible to obtain structured models of the scene, and on the other hand, control the quality of the reconstructed models in real time by comparing them with real vision. The idea is to design interactive modes that are simple for the user, and which offer optimal reliability.” An academic research field that lies between the “vision” community and the “computer graphics” community which Magrit has developed to a great extent these past few years.
2007

ALCHEMY CONSOLIDATES ITS WORK ON ITERATIVE COMPIlATION METHODS

In 2007, the Alchemy team’s recruitment of Grigori Fursin, who holds a PhD from Edinburgh University, allowed them to develop particular compilation methods, known as iterative compilation methods. This new approach makes it possible to adapt compilers to complex architectures. The work led to the design of a smart compiler (Milepost GCC) in partnership with IBM Research.

ALCHEMY: IMPORTANT INDUSTRIAL PARTNERSHIPS REGARDING THE "PROGRAMMING" ASPECT

Direct contracts as well as Cifre contracts have been signed with:
- Hewlett Packard France on the notion of programming optimisation (2004-2007);
- Philips (now NXP) on synchronous language programming approaches (2000-2009);
- ST Microelectronics on programming aspects for complex microprocessor architectures (2006-2010).

All of these relationships continue today in other research fields related to programming and architecture.

2007

ALCHEMY PROJECT-TEAM

Compilation/architecture interaction, at the heart of Alchemy’s research

The idea of creating interaction between compilation and architecture has come a long way… including with regard to European authorities. The team’s involvement in the HIPEAC network has had numerous consequences. Funding for the three research projects (Milepost, Sarc and Acotes) was for instance obtained from the European Commission: a total of 800,000 euro per year for three years (2006-2009). This made it possible to receive a number of PhD students and post-doctoral researchers, and to recruit Grigori Fursin. His mission was to develop iterative compilation techniques. From 2006 to 2009, the team’s research activities focused on compilation/architecture interaction to meet the objectives of the three European projects. “This meant that we had less leeway to concentrate on the other area that we wanted to develop in Alchemy, which is the growing complexity in technological development (Moore’s law) and the impact thereof,” explains Oliver Temam. “This refers to the second part of the acronym ‘Alchemy’, which stands for Architectures, Languages and Compilers to Harness the End of Moore Years.”
Medical applications for augmented reality

Applications in particular include computer-assisted medical interventions and the designing of surgical simulators. Since it came into being, Magrit has focused its research activities on medical imaging, in particular interventional radiology. In 2007, Erwan Kerrien got in touch with Stéphane Cotin of the Alcove project at the Inria Lille – Nord Europe centre. Their collaboration concerns the simulation of coil rollout in blood vessels (see page 44), and the modeling of vessels from 3D images (angiograms). Their aim is to obtain faithful, efficient representations of the vascular network in order to simulate operations in real time. Magrit has built on this work over the years and today the team’s research forms part of the large-scale action, Sofa InterMeds. Certain medical applications are being studied in conjunction with industrial partners: several theses have for instance been completed in collaboration with GE Healthcare in the scope of Cifre contracts, particularly on augmented fluoroscopy.
According to Moore’s law, the size of transistors in chips is halved every two years. This law has been followed for more than thirty years. “It was still valid when we created Alchemy, but we realised that it was being exposed to enormous pressure (excessive energy consumption and defects due to process technology), and we wanted to explore alternative routes.” Hence the need to develop new architectures and programming methods that are more energy-efficient and tolerant to defects in components. “The appearance of new applications, increasing constraints in terms of energy consumption and tolerance to defects, and lastly, the development of new electronic components (memristors), gradually led us to consider neuro-inspired architectures,” explains Olivier Teman. “To explore this direction, we recruited Hughes Berry, a biologist who specialises in the modeling of neurons, in 2010.” This line of research had previously remained somewhat in the background, since most of the team’s researchers had been working on European projects – a state of affairs that changed in 2009, when the European contracts came to an end.
Building animated 3D models of the vocal tract

The Magrit team began to study the acquisition of realistic models of dynamic organs for augmented reality or simulation applications. An example of this work is the design of an augmented head in view of language-learning applications. The idea is not to produce a talking head (visualisation of the face only), but an augmented head including both external articulators (lips) and internal ones (language, dynamic changes in the vocal tract).

This information is vital for teaching users to place their tongue correctly in order to produce a specific sound. “For this, it is necessary to obtain a dynamically articulate model of the face, the tongue, the palate… based on ultrasound images, videos, MRI, and from magnetic sensors,” says Marie-Odile Berger. Since 2006, in the scope of the European ASPI project (2006-2009), Magrit researchers had been working on the design of data acquisition and synchronisation systems. Today, they aim to build a first dynamic articulation model based on this data.
More changes, new projects to explore

With their major European contracts coming to an end, the team found the occasion to reorient their activities. The team members’ fields of interest had evolved, and they decided to put an end to the Alchemy project, since it had become difficult to harmonise the scientific topics of the various participants. However, it was also the ideal time to form new associations and new teams, both inside and outside of Inria. Grigori Fursin joined Intel Labs (Paris) to apply his compilation methods in an industrial environment. Albert Cohen, who had developed his activity on synchronous languages for data feed processing, participated in the creation of a new team (Parkas) on this topic. “For my part, I chose to set up an exploratory action, ByMoore, to study alternative architectures, possibly based on new technologies,” says Olivier Temam. “In the coming years, the nature of architectures will have to change, perhaps profoundly, because of technological constraints. Academic researchers have an important role to play in indicating the most promising directions for industry to follow. The ‘exploratory action’ working model that Inria offers is original: it runs over two years and involves just one researcher. It is the ideal tool for exploring a completely new direction and bringing flexibility to our research.”
MASTERMINDING THE FUTURE
Designated as a mediator in digital sciences, Inria is called upon to share its research with the general public. Its goal is to raise public awareness of the scientific dimension of digital technology, often perceived through technological applications. This is done by explaining the origin of innovations, and establishing debate on issues relating to digital sciences. By addressing the general public, Inria contributes to the recognition of this new field of knowledge and a discipline that will soon be taught in secondary schools.
Explaining digital sciences to as wide a public as possible

Digital sciences today play an essential part in our economy and society. It is therefore important to make them widely accessible and comprehensible. To this end, Inria has put in place a cultural and educational content offer for anyone who is curious to know more about science, as well as students and teachers.

Science on a festive note

Each year, the Fête de la Science gives Inria the chance to invite the public to come and meet its researchers. During the 2010 edition of this country-wide event, the artist Pierre Malaval put the spotlight on researchers in an exhibition called “1,000 researchers talk about the future”. He projected their portraits, accompanied by their vision of the future in one sentence, on the façade of the Pantheon in Paris. These included 26 Inria researchers and their 26 promises, some enthusiastic, others poetic, for a bright new digital world.

In Bordeaux, researchers from the Phoenix team made use of the occasion to present – among other things – the part of their research project that concerns healthcare at home. In a workshop called “In your home tomorrow, there will be applications for just about everything!” the public was able to discover different examples of possible applications of their research related to the protection of people and possessions, as well as assistance for the disabled. The Inria Grenoble – Rhône-Alpes centre for its part welcomed nearly 750 people, including 190 school children, during an open day.
Inria has designed a poll to assess the way in which French people learn about and evaluate the issues regarding the rollout of digital technologies, in a field that fascinates as much as it repels. Knowing more about the general public’s fears and expectations enables us to give them the information that they need.

A one-on-one poll with a sample of 1,200 people who are representative of the French population aged over 14 will ensure a good stability of the survey conditions and allow an interpretation of how opinions change.

“One of Inria’s missions of general interest is to help the public understand the changes that are brought about by the spreading of digital technologies, and to contribute through an educational endeavour to combating disinterest amongst young people for scientific fields.”

MICHEL COSNARD, CHAIRMAN AND CEO OF INRIA.
The Inria platform, a vibrant spot

In February 2010, as part of the EuraTechnologies programme, a centre of excellence dedicated to information and communication technologies was opened in the Nord – Pas-de-Calais region. The principal aim of the 200 m² area is to offer demonstrations that show the researchers’ technical expertise as well as joint projects between research teams, industrial partners and entrepreneurs. But the platform is also open to national or regional events aimed at a young school audience, such as the Fête de la Science or the Careers Olympiads. The Inria platform’s staff, in partnership with EuroTechnologies Développement, conducts awareness programmes with secondary schools close-by in the Bois-Blanc neighbourhood of Lille.

Mediation, a shared concern

Developing scientific mediation, in other words all actions that reach out to the public, is an ambition of Inria that receives considerable support from all its staff members. Pascal Guitton, head of research, sees it as a way to try and help reduce the “digital divide”. “Digital technology is a revolution to which many people are only spectators,” he admits. “And yet, it raises a large number of economic, social and ethical questions. From this point of view, I believe it is our duty to explain to the general public what we are doing and where we are going. We have various means of doing this: websites like Interstices, events that are open to as many people as possible, and mass-market media or social networks.”

OPERATION VIRTUAL PLANTS

Virtual Plants was the second Inria team to participate in the “One researcher, one operation” initiative at the Palais de la Découverte in Paris in February 2010. Researchers from Sophia Antipolis - Méditerranée exhibited their work in the field of plant modeling. The “operation” explained in understandable language how genes determine the development of plant forms, through the manipulation of virtual plants. This drew enthusiastic reactions from both the large number of visitors – even the very young – as well as the researchers involved in the operation.
GET-TOGETHERS AT THE “CAFÉ DES TECHNIQUES” (“TECHNOLOGY CAFÉ”)
Organised by the Musée des Arts et Métiers and the French association for the promotion of science (Association française pour l’avancement des sciences), Inria researchers regularly participate in these events. Two of our researchers, David Simplot-Ryl and Frédéric Desprez, were asked to talk about smart communicating devices and cloud computing, respectively.

A unique experience in the Moroccan desert
The Sultan Marathon des sables included a new kind of runner: Guillaume Chelius, a research scientist in the DNET team and experienced marathon runner, ran 250 km over seven days, equipped with 16 sensors in order to study the movements of his body, his performance, and how he adjusted to the environment, weather conditions and fatigue.

Everyone connected in Grenoble
The Inria Grenoble – Rhône-Alpes centre took part in the project set up by La Casemate CCSTI (scientific and technical cultural centre) to organise a large exhibition on digital objects, under the name “Tous connectés?” (“Everyone connected?”). Held from 22 October 2010 until 27 March 2011, the exhibition was designed to question the public about the use of these technologies that could potentially infiltrate all areas without us being aware of it, as well as the way in which people adopt them, and how they penetrate society. Inria contributed to the production of videos and a cultural programme that included a conference debate on the topic “Internet and privacy”. Inria co-organised a guided tour of the city in augmented reality, through the application “Grenoble Ville Augmentée” (developed in cooperation with the tourist office and Stendhal University). In 2011, the exhibition moved to the Cité des sciences et de l’industrie (science museum) in Paris.

To share this adventure, Inria has produced a video mini-series, broadcast on its Youtube channel.
Acroban is a humanoid robot developed by the Flowers team in Bordeaux, in collaboration with the University of Bordeaux 1, to investigate the role that the shape of the body plays in the learning of movement, and walking in particular. The robot has two original aspects: a spinal column, and a flexible body. “These two characteristics allow Acroban to be stable, move about without falling, and adjust spontaneously when it encounters obstacles,” according to Flowers team leader Pierre-Yves Oudeyer. Thanks to its shape and its physical construction, it is also the first humanoid biped capable of smooth, intuitive, robust interaction, even with children. It was in fact when they went to do a demonstration at the Science Museum in Naples that the researchers discovered that the robot could be taken by the hand and led around. “The visitors, especially little girls, came up and touched it, and directly manipulated it,” says Pierre-Yves Oudeyer. This live experience confirmed his convictions: “I believe that it is very important to interact with the public,” he says. “Science in general doesn’t communicate well. This is partly due to scientists who, in the 20th century, concentrated on technological progress conducted by and for themselves. They did not answer the question of what their research meant. I believe on the contrary that we have to explain its meaning, bring technology and science back into the heart of society, and establish a publicly oriented dialogue to explain the human stakes of the work that we do.”
Teaching computer science in high school, soon to be a reality

It’s an undisputed fact: IT changes the way people think. “The younger generations are born into it,” admits Nazim Fates, a research scientist and member of the Maia team at the Nancy – Grand-Est Inria centre. But for one thing, the use of IT tools is not entirely without danger; and besides that, there’s a whole science hidden behind computers. Young people are not necessarily aware of that. They must be encouraged to think about it, so that they won’t be uninformed users. We also hope to give them a taste for science, which a lot of them have unfortunately been drifting away from lately.” This is the whole purpose behind the optional subject “Digital science and technology, offered to school pupils aged 15-16 in three pilot education authority areas: Nancy, Versailles, and Nice. “The idea was to give pupils the chance to put the knowledge to practice,” says the researcher, who provided support to teachers in Nancy throughout the school year. “My role was also to explain to them the importance of computer science in research today. We make them aware of scientific issues raised by IT, particularly in its relationship with society.” Each school term, all the teachers were invited to a day of discussion based on scientific talks. At the end of the year, the pupils presented their work during a visit to the Inria centre, which ended with a talk by Gérard Berry, holder of the Chair in computer and digital sciences at the Collège de France and a passionate pedagogue. “Conducted with scant resources, but a lot of time and energy from the teachers who were involved, this experiment creates a precedent from which we can learn much, and which marks the beginning of an ongoing dialogue between researchers and teachers.”
KEY ISSUES FOR THE INTERNET OF TOMORROW

NEW ISSUES, NEW CHALLENGES, NEW DANGERS, NEW FEARS... TOMORROW’S INTERNET, FOR WHICH TODAY’S RESEARCH IS ALREADY GIVING THE OUTLINE, FORMS THE CRUX OF NUMEROUS DEBATES, IN PARTICULARLY REGARDING THE PROTECTION OF PRIVACY.

ANNE-MARIE KERMARREC: The filtering of information, and customisation more especially, is one of the key factors in internet development. Users will need information that is more contextualised, and that is distributed and filtered according to their profile.

DOMINIQUE CARDON: In this respect, we’ll be needing more and more sorting and hierarchy tools to obtain information that is adapted to a given context.

ANNE-MARIE KERMARREC
After spending four years in the Microsoft labs in Cambridge, England, Anne-Marie Kermarrec joined Inria in 2004. Today, as a senior research scientist and member of the Asap project-team, she focuses more particularly on a decentralised approach to internet browsing (GOSSPLE project).

DOMINIQUE CARDON
A sociologist in the Usage Lab at Orange Labs and associated researcher at the Social Movements research centre (CEMS/ EHESS), Dominique Cardon is interested in the transformation of the public domain under the influence of new communication technologies, as well as social networks and online identity forms.
A.-M.K: This is an inevitable development that raises questions regarding the protection of privacy. Providing pertinent information requires knowledge of the context and the internet user’s profile. However, all this data today is in the hands of major companies like Google or Facebook, the security and confidentiality guarantees of which are on the whole relatively weak. My research on the decentralisation of this information can play a role with regard to this issue which raises a number of scientific challenges.

D. C.: The moment this information is no longer in the hands of a single entity, but distributed on the network and gathered on the fly for a specific purpose, the “Big Brother” danger disappears. Having said that, interpersonal surveillance – aggravated in particular by the use of social networks – is likely to bring along new problems. For instance, a private conversation can be hijacked by a recruiter and used to the detriment of a potential job candidate.

**TALKING DEVICES!**

For Inria’s DNET team, led by Éric Fleury, sensor networks represent one of the major stakes of tomorrow’s internet. Whether in the scope of home automation or in the work environment, in future, devices will communicate with each other! To prepare for this new era, the team set up a trial platform in February 2011, which is open to researchers and industrial partners. The aim is to work on protocols for interaction between devices as well as interconnection between networks (fibre, Wi-Fi, ADSL, etc.). The project also includes a part that is closer to users, regarding applications that for instance let you turn your box into the central brain of your home, or supervise the equipment on your premises remotely.
What will the city of the future look like?

The spread of low-rise suburban housing, big cars and hypermarkets… The dominating model that was imagined in the 1950s no longer fits the challenges of our time. The moment has come to rethink our cities.

**MICHEL PARENT:** Transport is one of the major issues of urban planning, particularly private cars. With the continuously growing concentration of people in cities, there is simply no longer enough room for each person to use and park their own personal car.

**ROLAND CASTRO:** For the past century, looking beyond this problem, conceiving the city of the future has raised a real question of civilisation. We have to get rid of chopped-up areas, unbearable neighbourhoods right next to marvellous places… in order to regain a decent urban environment! We must therefore go beyond the inequalities produced by liberal economics. As far as
I’m concerned, I militate in favour of a city where, on a physical as well as spatial level, any neighbourhood is as good as another. We must stop building industrial and business zones and instead evolve towards projects that foster a shared idea. Today, too many areas live completely separated from each other!

**M. P.** In the new city, cars will be shared. As a supplement to public transport, they will no longer be social symbols. This cultural evolution will be difficult, just as it was to move from horses to motor cars, but when you propose alternatives that are more convenient and less expensive, people make the right choice.

**R. C.** Car-pooling is definitely a part of the city of the future. This is all the more healthy and inevitable when you consider that, the poorer you are, the more expensive this social marker is. But a city cannot be summed up by economic problems, systems and rationalities. It is also and above all a question of well-being and harmony. This is for instance why I prefer “soft” transport, such as trams rather than buses or boats on the Seine, because they are less disturbing to the poetry of the city.

**M. P.** This is why I also think that automation is an essential part of the solution. Automated cars use technologies that reduce air and sound pollution, and that therefore contribute to better harmony. Moreover, the car-pooling model can only work if automated vehicles are used because, like the self-service bicycle system, cars will have to be redistributed in the city.

**R. C.** Besides transport, living areas must be redesigned in light of the development of the digital world. The more virtual technologies are developed, the more time we spend at home, the more important the place where we live becomes. This will even be the fundamental issue of cities in the future.

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**A CITY WHERE YOU ONLY HAVE TO LIFT YOUR FINGER**

A city where you can merely wave your hand to open the door to a car park or switch channels on your TV… Led by Laurent Grisoni, the Mint team (Methods and tools for gestural interaction) looks at new forms of interaction between man and machine. Its research, based on the study of users’ gestures, aims to create new interactive experiences. These have already been made a reality in an interactive touchpad, as well as applications in which mobile phones and tablets serve as intermediaries to this dialogue between man and everyday devices. This activity has further been developed by the Mint team’s collaboration with the SME Idées-3com, which specialises in interactive 3D applications.
What role will cars play in the cities of the future?

INCREASED TRAVEL AND GREATER RELIANCE ON PERSONAL CARS, TRAFFIC CONGESTION... OUR LIFESTYLE HAS BROUGHT ABOUT NEW PROBLEMS. TO TAKE ON THE CHALLENGES OF THE FUTURE, WE HAVE TO RETHINK THE ROLE THAT CARS WILL PLAY IN IT.

MICHEL PARENT: Today, there are too many cars and not enough place to park or drive them. Our relationship with cars will therefore have to evolve towards mobility modes that favour rationalisation, such as car-pooling, multimodality, and the development of environmentally-friendly alternatives.

BRUNO MARZLOFF: Too much travelling destroys mobility! For over a century, transport has been key to the development of cities, but urban expansion has been synonymous with traffic congestion. There are on average 600 cars per 1,000 inhabitants, with each being used for just 5 to 10% of its lifespan. There is therefore an opportunity for improved productivity through the development of car-pooling as opposed to individually owned automobiles.

M. P.: Automation is an essential part of the solution. The pooling model can only work if one deploys automated vehicles because, as with bicycles at present, cars will have to be redistributed throughout the city.

BRUNO MARZLOFF
CEO and founder of Chronos, a sociological survey and innovation consultation firm which observes, questions and analyses the development of mobility issues. Bruno Marzloff is the author of several works including Le 5e écran. Les médias urbains dans la ville 2.0 (“The 5th screen. Urban media in the 2.0 city”), and Pour une mobilité plus libre et plus durable (“Towards a freer, more sustainable mobility”).
B. M.: We’re trying to modernise in the wrong place: the solution does not lie in the object! To reduce travel, we must first of all get away from the “Le Corbusier” approach to city planning where you have workplaces on one side, and commuter neighbourhoods on the other. And we are also being subjected to an accumulation of mobility that we can counteract by making use for instance of the increasing availability of digital infrastructures. In the future, we’ll be able to do more and more things remotely, like working or shopping.

“Automation is an essential part of the solution.”
What role will digital technology play in consumerism of the future?

The exponential development of the internet has already changed behaviour in a profound way. More and more French people are buying on the web. Technologies that help to improve traceability, such as RFID chips, have also contributed to progress in consumerism by improving health safety.

Consumption is becoming more and more digital. Soon we’ll be able to do our shopping on peripherals such as mobile phones,

THE DEVELOPMENT OF DIGITAL TECHNOLOGY IN CONSUMER HABITS IS OVERTURNING BEHAVIOUR PATTERNS: ONLINE SHOPPING, BETTER PRODUCT TRACEABILITY... THE SERVICE RENDERED IS NOT CONTESTED, ON THE CONTRARY. BUT DIGITAL CONSUMPTION DOES RAISE SOME WORRYING ISSUES, FOR INSTANCE REGARDING PRIVACY.

THIERRY SANIEZ: Consumption is becoming more and more digital. Soon we’ll be able to do our shopping on peripherals such as mobile phones,
on public transport, for example. The advantages in terms of saved time and service are undeniable. But it doesn’t mean that stores will disappear. The virtual and the physical will continue to exist alongside each other; certain products like clothing are not – or less – suitable for online shopping. At the same time, digital consumption poses new problems, for instance regarding the protection of private information. No need to be a soothsayer or great technician to realise nowadays that the information we leave on a website when we shop will be sold and exploited by others.

**D. S.-R.:** The consumer modes that are taking shape today will indeed bring data management into question. The buyer’s route will in future depend on a combination of media: he will first of all go to the store to be scanned and obtain an avatar that resembles him, then he can try on various models at his own convenience at home via the internet, and track his order on his mobile phone. Each time, he will find a personalised interface based on his profile and all the data regarding his order. From a technical viewpoint, we already know how to do it. But the questions regarding the storage of information still stand: who, between the telephone operator and the vendor, will get the upper hand when it comes to storing information on the user? Who will guarantee respect for his privacy? etc.

**T. S.:** The development of nanotechnologies must also be kept in mind when we look at the evolution of consumer habits. This technology is booming and will also revolutionise our models by its presence in our daily lives. Again, we must remain watchful and establish debates on the risks that consumers take.

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**AN INCREASINGLY PERSONALISED OFFER**

With the internet in particular, consumers have much more information and a wider range of products to choose from. In order to help companies design an offer that is adapted to their needs, the Dolphin team, and in particular Luce Brotcorne, is working on mathematical financial problems. The aim is to develop a strategy for selling the right product to the right customer, at the right price and the right time, according to the analysis of consumer behaviour. His work is already used by companies in the railway sector as well as in aeronautics (yield management). The extension of his mathematical models is currently underway in the fields of energy and the logistics chain.
Masterminding the future

Debate between Bruno Raffin and David Cage

What is the future of digital entertainment?

SUPPORTED BY THE CONTINUAL DEVELOPMENT OF NEW INNOVATIONS, VIDEO GAMES ARE BECOMING INCREASINGLY POPULAR WORLD-WIDE AND ACROSS GENERATIONS. TODAY, A NEW BREAKTHROUGH IS NEARING FRUITION, IN THE FORM OF EVER GREATER INTERACTION BETWEEN REAL AND VIRTUAL WORLDS, WITH RECENT DEVELOPMENTS IN VIRTUAL REALITY LEADING TO THE MARKETING OF NEW LEISURE ACTIVITIES.

BRUNO RAFFIN: Current technologies point to numerous development possibilities. Any peripheral today, from traditional PCs to mobile phones, is capable of displaying quality images. At the same time, interfaces are evolving. Gamepads are making place for more natural tools, based on movement sensors; the idea is to collect ever more information from real life to feed the virtual worlds and thus favour interactivity between the real and the virtual. In future, users could be represented in digital space in a much more natural, faithful way, like in the lab tests we are doing on the Grimage platform, for example.

DAVID CAGE: Beyond technical considerations, the interactivity procured by video games puts the individual in the role of an active player and not, as in cinema, a mere spectator. From this point of view, video games today are still seen as escape mechanisms, with violence often being the most noticeable aspect of the fictions they contain. But in recent years, with the appearance of games that target a more feminine audience, children or families, things have evolved somewhat. Having said that, if video games really want to win their spurs in cultural entertainment, they will have to adapt in order to convey meaning and emotion.

B. R.: The development of virtual 3D spaces shared over a network, the ability to interact in a more natural way and be represented more faithfully
in these worlds are opening up the way to applications that will surpass the realm of video games. As the Second Life application has begun to suggest, it is likely that these 3D environments in future will become the medium for a new generation of social networks that will offer advanced communication tools, whether for work, family or entertainment.

D. C: This is indeed already the case. Tactile interfaces, particularly in mobile telephony, are opening up new opportunities, particularly in the field of interactions between real and virtual. Some sort of physical control, with a joystick or other similar object, is however still necessary, since the mere sensing of movements poses too many problems. Nonetheless, I am convinced that if we fail to deliver in terms of emotions and meaning, video games will fail to become a mass-market entertainment product, and simply become a niche product for a handful of aficionados.

David Cage
Video-game designer David Cage is the founder and CEO of Quantic Dream. His studio developed The Nomad Soul, Fahrenheit and Heavy Rain, console games that achieved international success on the market, particularly for their emotional dimension.

**VIRTUAL WORLDS THAT ARE MORE AND MORE REAL**

Technological developments are making it possible to create increasingly realistic virtual worlds. Through its work on algorithms, the Reves team and in particular its team leader George Drettakis, has contributed to this evolution. The improvement in image and sound quality resulting from this research has benefited a variety of fields: video games, cinema, 3D reproduction of archaeology sites… They are also applicable to social issues. The team is for instance working in collaboration with psychiatrists on a project for treating phobias, by placing the patient in a reproduction that is as faithful to reality as possible (cf. pp. 18-19).
Should we be worried about the dominant role that digital technology plays in entertainment?

SUSTAINED BY THE CONSTANT DEVELOPMENT OF NEW INNOVATIONS, VIDEO GAMES ARE INTENSIFYING THEIR HOLD ON PEOPLE OF ALL GENERATIONS THE WORLD OVER. TODAY, THEY ARE ON THE BRINK OF ENTERING A NEW PHASE: GREATER INTERACTIVITY BETWEEN REAL AND VIRTUAL WORLDS IS GIVING RISE TO NEW GAMING PRACTICES.

EMMANUEL FORSANS: Recent developments in video games, particularly in terms of accessibility, have broadened the initial geek target to a much wider audience. You no longer need to be a joystick expert to play with the latest generation of consoles.

BRUNO RAFFIN: Touch-screen interfaces and sensor-based systems have played an important part. Moreover, with the development of technologies that allow you to play on any peripheral device, including mobile phones, image quality is no longer a vital criterion for all audiences.

E. F.: Getting immersed in a virtual reality is merely a consequence of the development of increasingly natural interfaces; it is not the specific objective of game manufacturers for a simple reason: it doesn’t bring in money.

B. R.: This doesn’t take away from the fact that the development of new interactive and digital presence modes is essential for revealing the full potential of 3D environments. Applications are going beyond video games. These shared 3D cloud environments should become advanced communication and exchange areas, the medium...
for a new generation of social networks. The emergence of peripheral devices which can generate avatars that look a lot like the users will perpetuate their remote presence.

**E. F.:** That shouldn’t worry us in itself, since immersion has never been the crux of the problem of addiction that is too often associated with video games. The lottery is not an immersive game, and yet it’s the one that is the most addictive. As for avatars, it’s after all more exciting to get into the skin of a hero!

“**The development of new interactive and digital presence modes is essential. Their applications go beyond video games.**”

**EMMANUEL FORSANS**

General Manager of the French bureau for video games (AFJV), Emmanuel Forsans has been working in this field for more than 20 years. He has also written a number of works on computer graphics and 3D, and lectures at the University of Paris VII (Paris Diderot).
Staff, contributors and project-teams (December 2010)

Number of staff members in each centre and at headquarters

Overall staff numbers

Non-Inria staff (1,724)

4,290
Total number of employees in France (3,429 scientists, 861 support staff), excluding interns

Scientists include:

- Researchers and research-lecturers 1,375
- PhD students 1,273
- Post-doctoral researchers 262
- Contractual engineers 519
<table>
<thead>
<tr>
<th>Figures as at 31 December 2010</th>
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<tbody>
<tr>
<td><strong>Recruitments</strong></td>
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<tr>
<td>Including from abroad</td>
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<tr>
<td>Foreign guest scientists hosted in the course of 2010</td>
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<tr>
<td><strong>Foreign guest scientists hosted in the course of 2010</strong></td>
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<tr>
<td><strong>Number of foreign students received in the scope of the Internship programme</strong></td>
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<tr>
<td><strong>Interns received in 2010 (flow)</strong></td>
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<tr>
<td><strong>Project-teams</strong></td>
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<td>Project-teams created in the course of 2010</td>
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<td>Project-teams terminated in the course of 2010</td>
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<tr>
<td><strong>Project-teams terminated in the course of 2010</strong></td>
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<tr>
<td><strong>Technological development actions, TDA</strong></td>
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<tr>
<td><strong>Framework agreements with universities, engineering schools, research organisations</strong></td>
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<tr>
<td><strong>Framework agreements or partnerships with industrial partners</strong></td>
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<tr>
<td><strong>Participation in European projects of the 7th FPRTD</strong></td>
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<tr>
<td><strong>Number of ERC grant holders in Inria project-teams in 2010</strong></td>
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<tr>
<td><strong>Associate teams created during the year</strong></td>
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<tr>
<td><strong>Associate teams around the world</strong></td>
</tr>
<tr>
<td><strong>Scientific publications</strong></td>
</tr>
<tr>
<td><strong>Conferences organised or co-organised by Inria</strong></td>
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</table>
Some activity indicators in 2010

- **6** start-ups founded in 2010: Verbatim analysis Vera, Lyatiss, Sysfera, Karrus ITS, Powedia, Robocortex
- **111** software programs filed
- **8** I-Labs founded or in the process of being founded
- **105** start-ups founded in total
- **21** patents filed in 2010
- **271** active patents
- **90** technology transfer projects underway
### Budget for 2010

**(in €M excl. tax, excl. balancing operations)**

<table>
<thead>
<tr>
<th></th>
<th>Pre-budget 2010</th>
<th>Final budget 2010</th>
<th>Executed budget 2010</th>
<th>Forecast for 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Income</strong></td>
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<td></td>
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<tr>
<td>• State allocation</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>(subsidy for civil-service charges)</td>
<td>166.567 (75.7%)</td>
<td>164.992 (65.3%)</td>
<td>164.992 (64.7%)</td>
<td>167.704 (63.3%)</td>
</tr>
<tr>
<td>including: – basic allocation</td>
<td>163.531 (98.2%)</td>
<td>161.955 (98.2%)</td>
<td>161.955 (98.2%)</td>
<td>164.700 (98.2%)</td>
</tr>
<tr>
<td>– Subsidy associated with the post-doctoral programme</td>
<td>3.036 (1.8%)</td>
<td>3.036 (1.8%)</td>
<td>3.036 (1.8%)</td>
<td>3.560 (2.1%)</td>
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<tr>
<td>• Own resources</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>including: – Research contracts</td>
<td>33.562 (64.5%)</td>
<td>40.885 (62.1%)</td>
<td>43.970 (64.3%)</td>
<td>53.619 (74.7%)</td>
</tr>
<tr>
<td>– Finalised research support (including donations)</td>
<td>6.429 (12.5%)</td>
<td>7.648 (11.6%)</td>
<td>7.329 (10.7%)</td>
<td>3.920 (5.5%)</td>
</tr>
<tr>
<td>– Development and service products</td>
<td>2.159 (4.2%)</td>
<td>3.490 (5.3%)</td>
<td>3.174 (4.6%)</td>
<td>1.613 (2.2%)</td>
</tr>
<tr>
<td>– Investment subsidies (property and equipment)</td>
<td>7.527 (14.7%)</td>
<td>11.130 (16.9%)</td>
<td>10.264 (15.0%)</td>
<td>10.976 (15.3%)</td>
</tr>
<tr>
<td>– Other products and subsidies</td>
<td>1.649 (3.2%)</td>
<td>2.708 (4.1%)</td>
<td>3.643 (5.3%)</td>
<td>1.686 (2.3%)</td>
</tr>
<tr>
<td>• Flow to or from working capital</td>
<td></td>
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<tr>
<td>including: – Carry forward from the previous year - Other flows</td>
<td>+2.217 (100%)</td>
<td>+2.405 (11.1%)</td>
<td>+2.405 (11.1%)</td>
<td>+2.193 (8.7%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>220.116 (100%)</td>
<td>252.496 (100%)</td>
<td>255.014 (100%)</td>
<td>264.785 (100%)</td>
</tr>
</tbody>
</table>

| **Expenses**         |                 |                   |                      |                   |
| • Staff financed from State allocations | 115.392 (52.4%) | 116.331 (46.1%) | 115.542 (50.1%)     | 119.712 (45.2%)  |
| • Staff financed by own resources | 32.705 (14.9%) | 36.504 (14.5%)  | 37.191 (16.1%)     | 45.065 (17.0%)   |
| • Operation and current investment including: – Research and support activities | 53.581 (24.3%) | 73.411 (29.1%) | 57.564 (25.0%) | 73.564 (27.8%) |
| – Research support functions | 32.938 (61.5%) | 46.422 (63.2%) | 36.159 (62.8%) | 46.547 (63.3%) |
| – Scientific equipment | 20.643 (38.5%) | 26.989 (36.8%) | 21.405 (37.2%) | 27.017 (36.7%) |
| **Long-term investment operations** |                 |                   |                      |                   |
| including: – Scientific equipment | 16.863 (7.7%) | 26.250 (10.4%) | 20.261 (8.8%)      | 25.185 (9.5%)    |
| – Property transactions | 1.885 (11.2%) | 3.569 (13.6%) | 2.711 (13.4%)      | 2.020 (8.0%)    |
| – Other general means | 13.995 (83.0%) | 21.114 (80.4%) | 16.636 (82.1%)     | 20.815 (82.7%)   |
| • Reserve            | 0.984 (5.8%)   | 1.568 (6.0%)    | 0.915 (4.5%)       | 2.350 (9.3%)     |
| **Total**            | 220.116 (100%) | 252.496 (100%)  | 230.557 (100%)     | 264.785 (100%)   |
Project-teams active in 2010

**Applied Mathematics, Computation and Simulation**

**COMPUTATIONAL MODELS AND SIMULATION**


- **Defi** (3, 13): Shape reconstruction and identification. Saclay – Île-de-France. Houssem Haddar.


**STOCHASTIC METHODS AND MODELS**


**OPTIMIZATION, LEARNING AND STATISTICAL METHODS**


The figures in brackets correspond to the partners listed on p. 80
Algorithmics, programming, software and architecture

PROGRAMS, VERIFICATION AND PROOFS

- Typical (3, 13): Types, Logic and computing. Saclay – Île-de-France. Benjamin Werner.

ALGORITHMS, CERTIFICATION, AND CRYPTOGRAPHY

ARCHITECTURE AND COMPILING

- **Alchemy** (3, 36): Architectures, languages and compilers to harness the end of Moore years.
  Saclay – Île-de-France. Olivier Temam.

- **AI²**: Amdahl's Law is Forever.
  Rennes – Bretagne Atlantique. André Seznec.

- **Cairn** (3, 7, 19, 40): Energy efficient computing architectures with embedded reconfigurable resources.
  Rennes – Bretagne Atlantique. Olivier Sentieys.

- **Camus**: Compilation pour les architectures multicoeurs.
  Nancy – Grand Est. Philippe Claus.

- **Compsys** (3, 8): Compilation and embedded computing systems.

- **Mexico**: Modeling and Exploitation of Interaction and Concurrency.
  Saclay – Île-de-France. Stefan Haar.

**Networks, systems and services, distributed computing**

**NETWORKS AND TELECOMMUNICATIONS**

- **Dionysos** (3, 40): Dependability, interoperability and performance analysis of networks.

  Rennes – Bretagne Atlantique. Albert Benveniste.


**DISTRIBUTED SYSTEMS AND SERVICES**

- **Aces** (3, 40): Ambient computing and embedded systems.
  Rennes – Bretagne Atlantique. Michel Banâtre.

- **Adam** (3, 25): Adaptive distributed applications and middleware.
  Lille – Nord Europe. Laurence Duchien.

  Rennes – Bretagne Atlantique. Michel Hurfin.

The figures in brackets correspond to the partners listed on p. 80.
DISTRIBUTED AND HIGH PERFORMANCE COMPUTING


VISION, PERCEPTION AND MULTIMEDIA UNDERSTANDING

INTERACTION AND VISUALIZATION

- **Alice (3, 16, 32, 33): Geometry and Lighting.** Nancy – Grand Est. Bruno Lévy.


- **Aviz:** Analysis and Visualization. Saclay – Île-de-France. Jean-Daniel Fekete.

- **Bunraku (3, 7, 18, 40): Perception, decision and action of real and virtual humans in virtual environments and impact on real environments.** Rennes – Bretagne Atlantique. Stéphane Donikian / Georges Dumont.


- **In-situ (3, 36): Situated interaction.** Saclay – Île-de-France. Wendy Mackay.


- **Gravite (3, 11, 20, 21): Graph Visualization and Interactive Exploration.** Bordeaux – Sud-Ouest. Guy Mélançon.

- **Maia (3, 16, 32, 33): Autonomous intelligent machine.** Nancy – Grand Est. François Charpillet.


The figures in brackets correspond to the partners listed on p. 80.
Computational sciences for biology, medicine and the environment

OBSERVATION AND MODELING FOR ENVIRONMENTAL SCIENCES

- Clime (6): Coupling environmental data and simulation models for software integration.
- Estime: Parameter estimation and modeling in heterogeneous media.
- Fluminance (1): Fluid flow analysis, description and control from image sequences.
  Rennes – Bretagne Atlantique. Etienne Mémin.
- Magique-3D (3, 39): Advanced 3D numerical modeling in geophysics.
  Bordeaux – Sud-Ouest. Hélène Barucq.
- Sage (3, 40): Simulations and algorithms on Grids for environment.
- Dracula*: Multi-scale modeling of cell dynamics: application to hematopoiesis.
- Macs: Modeling, analysis and control in computational structural dynamics.
- Masaie (3, 43): Tools and models of nonlinear control theory for epidemiology and immunology.
- Mere (10, 17): Water resource modeling.
  Sophia Antipolis – Méditerranée. Claude Lobry/Alain Rapaport.
- Numed (3, 8, 28): Numerical medicine.
- Reo (3, 37): Numerical simulation of biological flows.
- Sisyphe: Signals and systems in physiology & engineering.
- Virtual plants (2, 17): Modeling plant morphogenesis at different scales, from genes to phenotype.

OBSERVATION, MODELING AND CONTROL FOR LIFE SCIENCES

- Bang (9): Nonlinear analysis for biology and geophysical flows.
- Comore (3, 23): Modeling and control of renewable resources.
- Digiplante (2, 14): Modeling plants growth and plants architecture.
  Saclay – Île-de-France. Philippe De Reffye.
- Magnome (3, 20): Models and algorithms for the genome.
  Bordeaux – Sud-Ouest. David Sherman.
- Symbiose (3, 40): Biological systems and models, bioinformatics and sequences.

COMPUTATIONAL MEDICINE AND NEUROSCIENCES

- Asclepios: Analysis and simulation of biomedical images.
- Athena: Computational Imaging of the Central Nervous System.
- Cortex (3, 16, 32, 33): Neuromimetic intelligence.
  Nancy – Grand Est. Frédéric Alexandre.
- Demar (3, 30, 31): Artificial movement and gait restoration.
- Neuromathcomp (3, 9, 35): Mathematical and computation neuroscience.
- Parietal: Modeling brain structure, function and variability based on high-field MRI data.
  Saclay – Île-de-France. Bertrand Thirion.

* Partner’s agreement pending.
Inria’s partnerships

1. Cemagref
2. Cirad
3. CNRS
4. École centrale of Lille
5. École des mines of Nantes
6. École nationale des ponts et chaussées
7. École normale supérieure of Cachan
8. École normale supérieure of Lyon
9. École normale supérieure of Paris
10. École nationale supérieure agronomique of Montpellier
11. Enseirb
12. Ensta
13. École polytechnique
14. École Centrale of Paris
15. Institut national polytechnique of Grenoble
16. Institut national polytechnique of Lorraine
17. Inria
18. Institut national des sciences appliquées of Rennes
19. Inserm
20. University Bordeaux 1
21. University Victor Segalen (Bordeaux 2)
22. University Michel de Montaigne (Bordeaux 3)
23. University Joseph-Fourier (Grenoble 1)
24. University Pierre-Mendès-France (Grenoble 2)
25. University of sciences et technologies of Lille (Lille 1)
26. University Charles-de-Gaulle (Lille 3)
27. University of Strasbourg 1
28. University Claude-Bernard (Lyon 1)
29. University of Marne-la-Vallée
30. University Montpellier 1
31. University of sciences and techniques of Languedoc (Montpellier 2)
32. University Henri-Poincaré (Nancy 1)
33. University Nancy 2
34. University of Nantes
35. University of Nice – Sophia Antipolis
36. University Paris-Sud (Paris 11)
37. University Pierre-et-Marie-Curie (Paris 6)
38. University Denis-Diderot (Paris 7)
39. University of Pau and of Pays de l’Adour
40. University Rennes 1
41. University of Versailles Saint-Quentin-en-Yvelines
42. University of Franche-Comté
43. University of Metz
44. University of Provence
45. Centrum voor Wiskunde en Informatica (The Netherlands)
46. PRES University of Bordeaux
47. University of Bologne (Italy)
48. University of technology of Troyes
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Chairman and CEO

Antoine Petit
Deputy managing director

Hervé Mathieu
CEO for Resources and Service Administration

Claude Kirchner
CEO for Research and Technology Transfer for Innovation

Nozha Boujemaa
Inria Saclay – Ile-de-France research centre

Patrick Bouthemy
Inria Rennes – Bretagne Atlantique research centre

Gérard Giraudon
Inria Sophia Antipolis – Méditerranée research centre

Isabelle Ryl
Inria Paris – Rocquencourt research centre

François Sillion
Inria Grenoble Rhône-Alpes research centre

David Simplot-Ryl
Inria Lille - Nord Europe research centre

Isabelle Terrasse
Inria Bordeaux – Sud-Ouest research centre

Karl Tombre
Inria Nancy – Grand Est research centre

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Éric Gautrin
Information Systems, Infrastructures, and Computer Services Department

Renaud de Vernejoul
HQ Administration Delegation

Chris Hankin
Chairman of the Scientific Council

Gérard Berry
Chairman of the Evaluation Committee
INVENT TO SERVE

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Franck Tarrier, Head of the software department, DGCIS
Grégory Cazalet, Head of department 3 (MIRES), Budget department
Éric Grégoire, Scientific training consultant to the general management of higher éducation, DGESIP
Christine Marteau, Manager of the Telecommunications Office, DGA

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Donatienne Hissard, Deputy director of scientific exchanges and research
Cécile Dubarry, Head of the Information and Communication Technologies Department, DGCIS
Jean-Luc Beylat, Chairman of Alcatel-Lucent Bell Labs France
Bernard Jarry-Lacombe, National secretary of the CFDT cadres executive trade union
Marie-Noëlle Jégo-Laveissière, Director of research and development, Orange Labs
Gilles Le Calvez, Director of R&D, Valeo Group
Jean-Yves Mérindol, Director of the École Normale Supérieure de Cachan
Luc Paboeuf, Chairman of the Aquitaine CESR (Regional Economic and Social Council)
Laure Reinhart, Deputy managing director, OSEO and OSEO Innovation
Gérard Roucairol, President of Ter@tec association

ELECTED MEMBERS
Representatives of the scientific personnel, engineers, technicians, and administrative staff
Serge Steer, Director of research, INRIA Paris – Rocquencourt, SNCS-FSU (collège A)

ADVISORY CAPACITY
Patrick Roger, Auditor général
Christian Serradji, Accounting Officer
Chris Hankin, Chairman of the Scientific Council
Antoine Petit, Deputy managing director of Inria

The annual report can be found at the following URL:

Scientific activity reports (in English) from the research teams can be found at the URL:
http://raweb.inria.fr/
Scientific Council

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