

Laboratories become international

Research structures encourage exchange and international collaborations.



>>> Juan MARTINEZ-VEGA, vice-president of Paul Sabatier University for international affairs.
Researcher at the LAPLACE laboratory (joint UPS/CNRS/INP laboratory).
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The international mobility of students, university professors and researchers is one of the most important factors in the current development of our establishments of higher education. In this way, the international visibility of our university depends above all on the quality and excellence of our teaching and research. Managed well, the international constituent, on small and large scales, can become a vector for modernizing our universities.

We must look for a balance between incoming students, professors and researchers and those going abroad through the implementation of European and international coordination.

Federative projects

In our university, and particularly within our laboratories, the cooperation between teams or researchers from various countries has always existed. We can even confirm that this cooperation is one of the bases of our research excellence. This cooperation takes very diverse forms today.

The first level is the one where contacts are established between researchers during seminars or conferences, or other meetings that sometimes lead to common projects over long or short periods. A more complex level of international cooperation involves European and international projects.

These projects require networks or teams from various countries to be set up around federal projects. We can also cite here common projects supported by specific bilateral agreements, between France and a partner country, for example.

For some years, and thanks to the CNRS, more long-lasting structures have been established that make these collaborations more effective by centering them around a research theme rather than on a particular project. The GDRE (European research groups), the GDRI (international research groups), the LEA (associated European laboratories) and the LIA (associated international laboratories) were created in this way.

Laboratories without frontiers

LEA and LIA include teams of researchers from at least two countries and which establish a common research program. These labels (obtained after an evaluation) also allow the researchers to obtain funding for the exchange. The UMI (international joint laboratories), which have more complex structures, appeared more recently. Here, researchers from one of the countries work permanently in the partner country laboratory site.

A large number of teams or laboratories at Paul Sabatier University are very active in international scientific collaborations. This magazine presents the main existing international structures that concentrate on themes as diverse as robotics, microelectronics, chemistry, life sciences, computing and geosciences.

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LAPLACE: Laboratoire Plasma et Conversion d'Energie/Laboratory on Plasma and Conversion of Energy

CBD : Centre de Biologie du développement/ Center of Developmental Biology

LHFA : Laboratoire hétérochimie fondamentale et appliquée/Laboratory for fundamental and applied heterochemistry

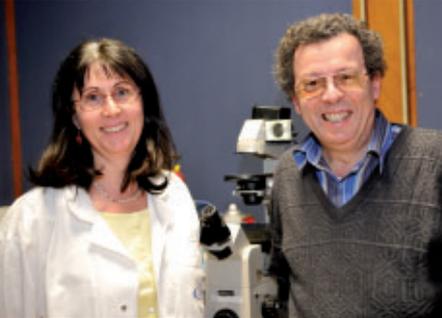
LCC : Laboratoire de Chimie de Coordination/Laboratory on coordination chemistry
LAAS : Laboratoire d'Analyse et d'Architecture des Systèmes/ Laboratory for Analysis and Architecture of Systems

LMTG : Laboratoire des Mécanismes et Transferts en Géologie/Laboratory for Mechanisms and Transfer in Geology

IRIT : Institut de Recherche en Informatique de Toulouse/ Toulouse institute of computer research

A Toulouse-Hong Kong “rocade” for life sciences

Rocade stands for Role of calcium in cellular determination and differentiation. It is the result of a fruitful collaboration between biology laboratories from Toulouse and Hong Kong.



>>> Catherine LECLERC, CNRS scientist and Marc MOREAU, CNRS senior scientist and lab director, both researchers in the Centre de Biologie du développement (CBD, joint UPS/CNRS laboratory)

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Marc Moreau's team at the Centre de Biologie du développement has recently formed an LIA (CNRS associated international laboratory) with Andrew Miller's group at Hong University of science and technology (HKUST). It is the first LIA created by CNRS with Hong Kong, and UPS is a partner in this association. This LIA is called Rocade (Role of calcium in cellular determination and differentiation) and is the result of an active collaboration which started more than 10 years ago between these two teams. The collaboration with Andrew Miller started in 1988 and has been supported by CNRS and the Foreign Affairs Ministry since the beginning.

The two labs complement each other when it comes to developmental biology and use *Xenopus* and Zebrafish as biological models.

Xenopus development

The teams study the role played by calcium in gene expression involved in early embryonic development, particularly in nervous system formation (neurogenesis) and in kidney development (nephrogenesis). The role played by calcium is analyzed by molecular biology techniques and photon counting imaging. This original imaging technique which exists in only a few labs around the world, allows to count photons emitted by a calcium-sensitive bioluminescent probe and to visualize calcium movement in a cell in vivo in time and space. This dynamic imaging has allowed to demonstrate spontaneous transient increases of intracellular calcium in a specific zone of the embryo. The increases are spatio-temporally modulated and correspond to the opening of specific calcium channels. These early elementary events have long term consequences for the cells and irreversibly decide

the fate of the cells in a neural differentiation pathway. This phenomenon, called neural induction, is at the origin of the embryonic nervous system. These experiments have allowed Marc Moreau's team to isolate the genes directly controlled by calcium and involved in nervous system development.

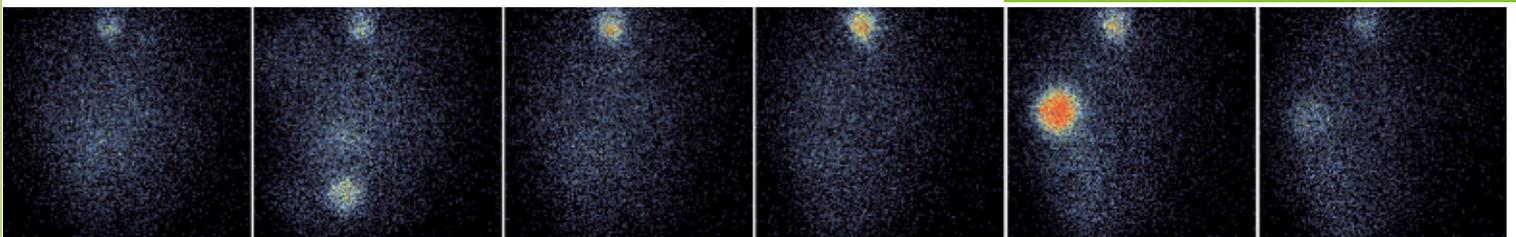
Joint publications

The collaboration involves team members visiting each other's laboratories for several weeks a year as well as joint publications.

The LIA is working toward several goals. It studies calcium-dependent genes involved in early development using several complementary biological models. The LIA also stimulates the development of new cellular dynamic imaging techniques using luminescent probes and photon counting and is open to new colleagues working in similar scientific fields. Two international meetings between specialists in calcium signaling and developmental biology from each country have been already organized and the third is being prepared. Finally the LIA encourages exchange of young researchers between UPS and HKUST.

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>>> Measurement of intracellular spontaneous calcium concentration increases recorded on the dorsal side of a *Xenopus* embryo, 10 hours after fertilization. The calcium movements are recorded with a luminescent probe: aequorin, which emits light when bound to calcium. The images are recorded with a PIM (Photon Imaging Microscope) from the laboratory in Hong Kong at 1 frame/120 seconds. Warm colors correspond to an increase in calcium concentration.



Chemical links between Toulouse and Barcelona

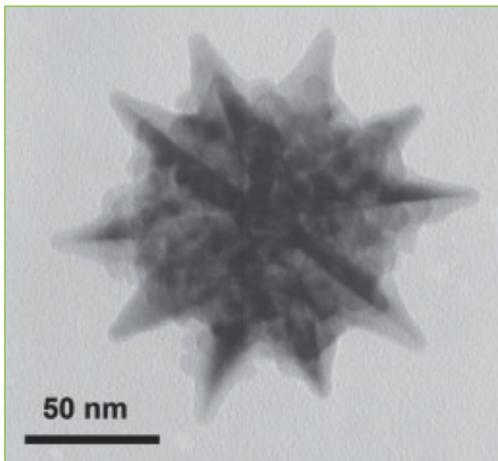
The links between universities and laboratories on both sides of the Pyrenees are getting stronger.



>>> Antoine BACEIREDO, CNRS senior scientist, head of Laboratoire hétérochimie fondamentale et appliquée (LHFA, joint UPS/CNRS laboratory).

In December 2006 a European Associated Laboratory (LEA), the "Transpyrenean Laboratory: from Molecule to Materials" (LTPMM) was created. It associates two big nearby regions: Catalunya (Spain) and Midi-Pyrénées (France). It gathers all in all thirteen CNRS teams, Paul Sabatier University, the University of Barcelona (UB), the Autonomous University of Barcelona (UAB) and the CSIC (Scientific Research Council, or the Iberian equivalent of the CNRS). Two laboratories in Toulouse are involved: the Laboratoire Hétérochimie Fondamentale et Appliquée (LHFA, UPS/CNRS) and the Laboratoire de Chimie de Coordination (LCC, CNRS associated lab with Paul Sabatier University). Thanks to a structured collaboration, all these teams wished to establish long-lasting relations between two big nearby regions in the field of molecular chemistry.

After the creation of the Federative Structure of Chemistry, which gathers the majority of Toulousian chemists, it seemed that there were already interactions between Toulouse and Barcelona, in particular, via bilateral programs such as PICASSO and PICS. Further analysis of the situation showed that these collaborations were not rivals but, in many cases, complementary. This LEA's project was launched around six themes: *Synthesis of metallic nanoparticles and their applications in catalysis - Towards C-C bond activation: C-C agostic interaction, a joint experiment / theory challenge - Proton transfer involving hydride*



>>> Palladium nanoparticles dispersed in an ionic liquid (TEM image). Highly active catalytic system for carbone-carbone bonds (collaboration with M. Gomez (LHFA) and G. Muller (UB))

complexes - Polymetallic dendrons and dendrimers. Synthesis, reactivity and use as catalysts - Asymmetric synthesis of phosphoryl- and boryl-substituted heterocycles and carbocycles - Processing and study of molecular materials as thin films.

Crossed collaborations

All these projects are situated within the frame of important objectives such as the development of new catalysts using dendrimers or metallic nanoparticles, with the aim to prepare new synthons or materials with specific properties. This LEA structure allows specialists in organic chemistry, coordination chemistry, theoretical and material chemistry to meet regularly and maintain collaborations. It is important to share our know-how, so that our projects are even more productive and so that the exchange between Toulouse and Catalan poles increases in both research and training. Indeed, the nearness of both regions facilitates the exchange of students and teachers. Furthermore, each side can benefit by sharing laboratory equipment.

The collaborations developed within the framework of this LEA are particularly productive since about fifteen high-level articles are published per year. Furthermore a French-Catalan conference on molecular chemistry is organized every two years, which allows the various partners to present their most significant results. This conference takes place alternatively in Toulouse and in Barcelona and the last one took place at the Autonomous University of Barcelona in January 2009.

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The Coordination Chemistry Laboratory makes the most of international cooperation



>>> Jean-Pierre MAJORAL, CNRS senior scientist ; Jean-Jacques BONNET, professor at UPS ; both at the CNRS Laboratoire de Chimie de Coordination associated with UPS

The Laboratoire de Chimie de Coordination, LCC, a joint CNRS/UPS laboratory has been involved in joint ventures like European or International Associated Laboratories (LEA/LIA) for the last ten years, with teams in Poland and Morocco. Continuing this tradition, it also leads several European (GDRE) or International (GDRI) Research networks.

The LEA "MOMACHEM" was established in January 1999 between the LCC and the Centre of Molecular and Macromolecular Studies (CMMS, Polish Academy of Sciences, Lodz) by Jean-Pierre Majoral, CNRS senior scientist at the LCC. It brings together the LCC and the LHFA of UPS and five teams at the CMMS in Poland. The collaboration is based on six main themes at the chemistry-biology interface, at the chemistry-material sciences interface and in the field of surface modification and catalysis that take into account the complementary expertise of both French and Polish partners. These themes encompass the chemistry-biology interface, zirconium and heterochemistry; physical chemistry of macromolecules; asymmetric synthesis; interaction between nanoparticles of silver and gold with spiroxazines; and enantiomerically pure chiral phosphines. Scientific research is supported by three

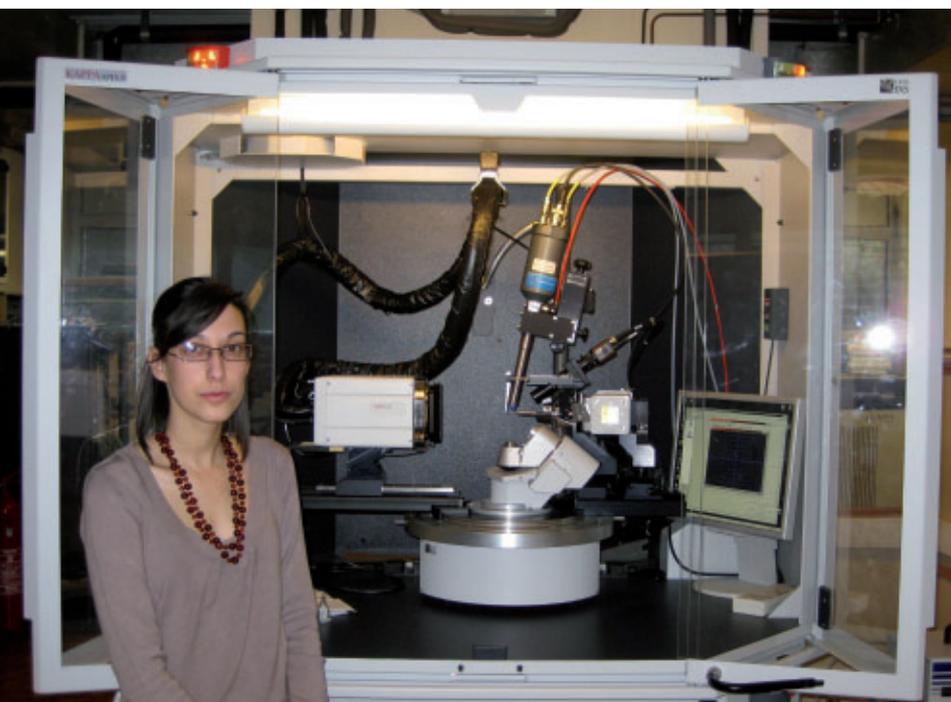
workshops, held alternately in Poland and France, which allow the coordination of research themes by an independent expert steering committee.

Long-term scientific missions

More than 80 joint scientific articles have already been published. Approximately 15 Polish and French researchers have benefited from long-term scientific projects in partner laboratories and two co-supervised theses have been supported. Advances in the field of enantioselective synthesis, catalysis in aqueous media, and transfection (chemistry-biology interface), as well as in the characterization and stabilization of various nanoparticles, are true success stories of the LEA, as is a start-up dealing with diagnosis built upon fundamental results obtained at the laboratory. It thus enjoys a strong international reputation and is often quoted as a model in Europe, China, and North America.

Joint Publications

Based on this first success, a second Associated Laboratory, a LIA in molecular chemistry, was established in January 2007 by Jean-Jacques Bonnet, researcher at the LCC and Emeritus Professor at UPS. This LIA brings together the skills of research teams both from the Toulouse UPS federation in molecular chemistry and from the chemistry departments of four universities in Morocco (Fez, Ifrane, Marrakech and Rabat). The collaboration is centred around three priority scientific areas -- chemistry and health, chemistry and nanotechnology and chemistry and sustainable development -- in the framework of co-supervised theses. It also aims at building tight links between the scientific and technical platforms of both parties and for involvement in university courses at the Master level. Five joint publications have already emerged from this "young" collaboration.



>>> X-ray diffraction instrument for determining the crystalline structures of materials prepared at LEA MOMACHEM and LIA LCCMF.

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Toulouse geochemistry with a Russian accent

Russian and French laboratories have founded a joint laboratory that will study the evolution of Arctic soil as the climate changes, and the formation of precious metal deposits underground.

In 2005, French and Russian laboratories created LEAGE (Associated European Laboratory for Experimental Geochemistry). The French element consists of the Laboratoire des Mécanismes et Transferts en Géologie LMTG, a joint UPS, CNRS and IRD laboratory. On the Russian side there are the departments of Geochemistry and Geography of the State University of Moscow (Lomonossov university) as well as the Institute of Geology, Mineralogy and Petrology of the Russian Academy of Sciences.

Release of carbon

The research activities of LEAGE have two main themes. The first one involves the speciation and transfer of chemical elements (carbon, metals) by terrestrial fluids in Arctic environments. These studies are carried out in the field and in laboratory experiments. For example, the transfer of carbon in Arctic circles is an important scientific question. In effect, the last report of GIEC (Intergovernmental Group on Climate Evolution, June, 2008) certifies that the Arctic regions are those subjected to the

strongest increases in temperature. As they constitute a major reservoir of carbon, notably in soil, it is crucial to study the effect of total climatic change on the possible release of carbon from soil towards the oceans and atmosphere.

The second research theme at LEAGE involves the speciation and transfer of elements in hydrothermal fluids. These studies are principally based on experiments in the laboratory and allow researchers to acquire fundamental knowledge on the transport of elements within terrestrial systems with high temperature and on the modalities of formation of metallic deposits with high technological and economic value (such as gold, antimony, silver and platinum).

Between France and Russia

LEAGE allows strong collaboration between French and Russian teams on subjects that require a complementary approach.

At the moment, three theses are in preparation with the students sharing their time between France and Russia. Several projects in the field (in Karelia, Archangelsk region) and working meetings allow LEAGE to advance rapidly. The laboratory published numerous articles - more than 40 articles and conference proceedings in 2008.

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>>> From left to right: François Martin, head of LMTG laboratory, professor at Paul Sabatier University; Bernard Dupré, Head of Midi-Pyrénées Observatory, French co-representative for LEAGE; Ekaterina Vasyukova, Paul Sabatier University and the University of St Petersburg; Oleg Pokrovsky, CNRS scientist, French co-representative for LEAGE; Sergey Lapitski, head of research, Faculty of Geology of Moscow, Russia; Jérôme Viers, professor, Paul Sabatier University.



>>> Dialysis experiment to recover the colloidal fraction of marshy water particularly rich in organic matter and iron oxides (from Karelia region, Russia)

headline

Robotics at the center of French-Japanese cooperation



>>> Jean-Paul LOMOND, CNRS senior scientist at CNRS lab LAAS associated with UPS and Eiichi YOSHIDA, senior researcher AIST.

Created in 2003 by the CNRS and the National Institute of Industrial Science and Technology (AIST), Japan, the International Associated Laboratory (AIL) Joint Japanese-French Robotics Laboratory (JRL) specializes in robotics research, particularly in humanoid robotics. Since November 2005, the JRL is organized over two sites: the JRL-Japan located at AIST Tsukuba and the JRL-France at Laboratoire d'analyse et d'architecture des systèmes (LAAS, a CNRS lab associated with Paul Sabatier University) in Toulouse. Each of the two centers hosts researchers of both nationalities.

Human-machine relationships

On the French side, the JRL hosts core researchers from the two most important CNRS laboratories in robotics, the LAAS and the LIRMM (Laboratoire d'informatique, de robotique et de microélectronique de Montpellier). Led by these researchers, the JRL collaborates with other French research teams.

Different projects at LAAS benefit from the platform HRP-2, a humanoid robot that measures 1.54m and weighs 58kg, as well as software and human resources.

This platform widens major research subjects on robotics towards questions on the interface between robotics and humans. It involves research specific to robotics, such as controlling complex mechanical systems. Other topics include: personal robotics and robotic assistants, studies on human-machine relationships, biomechanical research with a view to medical applications, understanding the computational mechanisms that give rise to human behavior by original approaches in synergy with neuroscience, and elaborating virtual digital human models that address critical issues in virtual reality, particularly in the domain of PLM (Product Lifecycle Management), graphical animation and video games.

Find a ball

Since the creation of the JRL, some hundred articles involving both French and Japanese researchers have been published. The progress made on the LAAS platform lies mainly in advanced motion control and biped locomotion: Today the HRP-2 robot can find a ball based on its color, localize it, approach it while avoiding obstacles, and take it and place it on a pre-defined position.

It is thanks to the work achieved in this framework that the CNRS and AIST created the International



>>> HRP-2: 1,54m, 58kg, 30 degrees of freedom, 4 cameras, 4 force sensors, 1 gyroscope, 1 accelerometer

Joint Lab (UMI) CNRS-AIST JRL (Joint Robotics Laboratory), UMI3218/CRT located at Tsukuba, while allowing CNRS to continue supporting research on the LAAS platform.

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>>> A training course session for robotic platform HRP-2

A bridge between Toulouse and Tokyo for micro- and nano- systems



>>> Christian BERGAUD, CNRS scientist at CNRS lab LAAS associated with UPS, ex-director of LIMMS (2004-2006)

LIMMS (Laboratory for Integrated MicroMechatronic Systems) is now one of the most famous laboratories in this field thanks to the close collaboration between French and Japanese researchers.

LIMMS, the first International Joint laboratory located in Asia, was established on 25 June 2004 by the CNRS and the IIS (Institute of Industrial Science), University of Tokyo, after 10 years of existence in a LIA (Associated International Laboratory). The UMI has a French director and a Japanese deputy director⁽¹⁾. It is composed of researchers from the CNRS and the IIS, and post-doctoral fellows whose scholarships are supported by the JSPS (Japan Society for the Promotion of Science).

Its creation also reflects a change in status because this new structure has brought greater operational autonomy to LIMMS and the opportunity to participate in national and European research programs and to involve major networks that structure research in this field.

Its strategic research goals are related to the development of technology clusters in micro- and nano-systems. They involve activities in the field of materials, technological processes, assembly and integration techniques including packaging, and in the field of modeling and systems design. From a fundamental point of view, the areas concerned are nanoscience, biophysics, and bio-inspired systems. The fields of applications are metrology, advanced communications, biology and healthcare.

Recruitment of postdoctoral fellows

Each year, LIMMS welcomes new CNRS research scientists for a period of two or three years. A campaign to recruit post-docs is also open each year. LIMMS allows the researcher to develop his or her research project and benefit from the considerable technological resources of IIS in micro- and nanotechnology, biophysics and molecular and cellular biology, and to take part of an environment of scientific excellence at the University of Tokyo. This structure is unique within the CNRS from a functional point of view since it hosts scientific researchers from very different backgrounds (technologists, physicists, chemists, biophysicists,



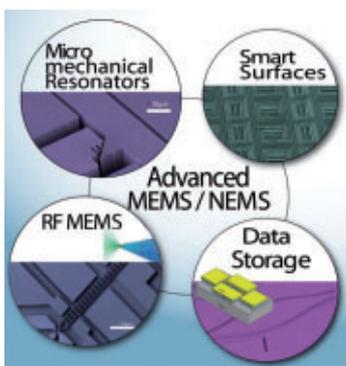
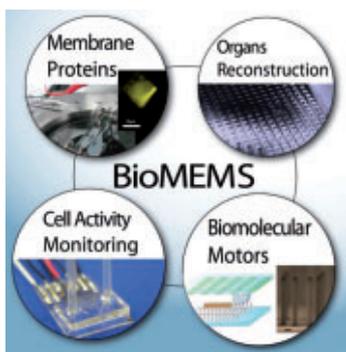
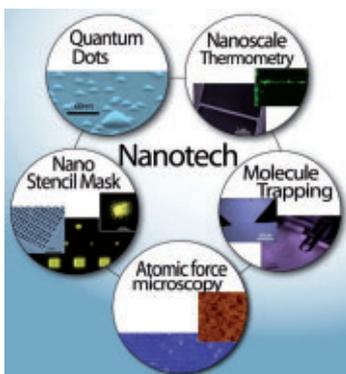
>>> The LIMMS building in Tokyo

biologists) in the same environment. This environment provides a stimulating arena for developing ambitious and multidisciplinary research projects, where each researcher brings in as much as he gets out.

Molecular motors

Such multidisciplinary has led to a few flagship projects in nano-biotechnology, in particular the study of molecular motors and surface science with the development of near-field techniques (scanning tunneling microscopy and atomic force microscopy) for the observation and characterization of biomolecules. These projects have enabled LIMMS to position itself at the forefront of the international scene in the field.

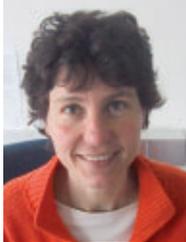
(1) : Actual Directors : Dominique Collard (collard@iis.u-tokyo.ac.jp), Teruo Fujii (tfujii@iis.u-tokyo.ac.jp)



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Interaction at the core of a French-Italian collaboration



>>> Laure VIEU, CNRS scientist at IRIT
(joint UPS/CNRS/INP/UT2 laboratory)
and ILIKS coordinator.

How does behavior influence communication between people? What decides whether two organizations cooperate or compete? Which factors are involved in communication among computers? Such questions are at the core of an interdisciplinary cooperation between French and Italian scientists.

Interaction among knowledge-based systems is the new paradigm for constructing a future society of intelligent agents. People, machines and organizations are more and more interactive thanks to new information and communication technologies. The social nature of interaction and communication processes needs to be acknowledged and addressed if these widespread technologies are to be effective and ultimately of benefit to society as a whole.

These issues have been studied for four years in a French-Italian collaboration involving around 70 researchers, professors, graduate students and post-docs in the framework of an associated European laboratory (LEA) called "Interdisciplinary Laboratory on Interacting Knowledge Systems" (ILIKS) that brings together the Institut de Recherche en Informatique de Toulouse (IRIT), the Institute of Cognitive Sciences and Technologies (ISTC) of the Italian CNR in Rome and Trento, and the University of Trento with three of its departments: Engineering and Information Science, Cognitive Science and Education, and Economics. The positive results obtained since 2005 means that the lab will continue with a second four-year agreement.

Social relations

The ILIKS studies the theoretical foundations of interaction using an interdisciplinary approach. It aims at developing rigorous models based on Cognitive Science, Linguistics, Philosophy, Economics as well as Logics and Computer Science. It addresses four topics. The first consists of modeling cognitive agents, the coherence and dynamics of their beliefs, their ability to make decisions, to choose objectives and to plan and take action, especially communicative action. The second is dedicated to modeling what turns a simple set of agents into a society, an organization or an institution: on one hand there are social interpersonal relations such as trust, responsibility and commitment, delegation, cooperation and on the other, conventions or institutional norms that set the roles and obligations that shape and regulate social groups. The third

involves modeling linguistic interaction, especially the structures and phenomena involved in communication and dialogue. Special attention is given to gestures and the visual dimension of communication. Finally, the fourth topic develops lexical and knowledge resources required to make sure that the contents of the interaction is spread among agents without being distorted.

Wide applications

This work is mainly theoretical, but has wide applications. The ILIKS partners are themselves involved in managing medical data in a healthcare organization; integrating web services and processes; natural language dialogue systems and interfaces; information extraction; sign language communication support; and extending the web to the "web of objects".

The ILIKS currently has several ongoing projects, including ForTrust (ANR project), which brings together members of both IRIT and ISTC, as well as the Ecole des Mines de Saint-Etienne. ForTrust aims at building formal models of trust and reputation. These ideas are omnipresent in open distributed systems, and especially in new applications of the Internet, such as electronic commerce, web services or peer-to-peer systems – just think of eBay or hotel recommendation sites. A rigorous formal model is also being developed on the basis of a cognitive theory of trust.

More information on: www.iliks.loa-cnr.it

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>>> ILIKS logo.