



Journées  
scientifiques  
du LAAS-CNRS  
40<sup>e</sup> anniversaire



Laboratoire d'Analyse et d'Architecture des Systèmes du CNRS

# Problématiques scientifiques : avancées et défis

## *Scientific Problems: Advances and Challenges*

### Programme

7, 8 et 9 octobre 2008  
LAAS-CNRS

## 40 ans d'aventure scientifique et humaine

Le LAAS célèbre cette année 40 ans d'existence. Créé en 1968 comme unité propre de recherche du CNRS, le « Laboratoire d'automatique et de ses applications spatiales » s'est très vite développé, avec un parti pris d'anticipation, dans d'autres disciplines qui allaient profondément modifier la vie scientifique, et révolutionner jusqu'à notre vie quotidienne : l'informatique, les micro et maintenant nanotechnologies, la robotique et les systèmes autonomes. Sans changer d'acronyme tout en tenant compte des évolutions de ses thématiques de recherche, il deviendra en 1973 le « Laboratoire d'automatique et d'analyse des systèmes », puis en 1994 ce qu'il est aujourd'hui, le « Laboratoire d'analyse et d'architecture des systèmes ». Qu'en est-il aujourd'hui dans ces problématiques scientifiques qui connaissent une évolution si rapide ? Comment, forts des avancées d'hier et d'aujourd'hui, se dessinent les défis de demain ?

Ces journées constituent un point d'orgue de la célébration de ce 40e anniversaire : des chercheurs du LAAS et des scientifiques invités font le point sur les avancées et mettent en perspective les défis posés dans les différents domaines de recherche du laboratoire. Le programme a été conçu afin de refléter pleinement les missions, les activités et les résultats du laboratoire : recherche académique de haut niveau, formation, coopérations nationales et internationales, partenariat avec le secteur économique.

## 40 years of scientific and human adventure

*This year, LAAS celebrates 40 years of existence. Created in 1968 as a research laboratory depending directly of CNRS (the French National Organization for Scientific Research), the "Laboratory for Automatics and its Applications to Space" has rapidly evolved to anticipate others scientific fields that were going to modify profoundly the scientific life, and even to revolutionize our everyday life: information processing, micro and now, nanotechnologies, robotics and autonomous systems. Without changing acronym, while taking into account the evolution of its research topics, in 1973 it became the "Laboratory for Automatics and Analysis of Systems", and then in 1994, what it is today, the "Laboratory for Analysis and Architecture of Systems". What is today the status for such rapidly evolving scientific problems? How, building on yesterday and today advances, are tomorrow's challenges shaped?*

*This Workshop constitutes a salient feature of the celebration of this 40th anniversary: LAAS researchers and guests scientists review the advances in the various research domains of the laboratory and put into prospect the related challenges. The program has been designed to fully reflect the missions, activities and results of the laboratory: top-level academic research, education and training, national and international cooperations, partnership with the economic sector.*

Accueil — *Welcome*

13h30

**Micro et nano systèmes**  
**Micro Nano Systems**

**14h-18h15**

- Nanofabrication par combinaison : nanostructuration et autoassemblage  
*Combinational nanofabrication: nanopatterning and self-assembly*  
Clivia Sotomayor, Catalan Institute of Nanotechnology (ICN-CIN2), Barcelone, Espagne
- Micro et nanotechnologies au service des sciences du vivant et de la médecine  
*Micro and nanotechnologies for life sciences and medicine*  
Christophe Vieu, LAAS-CNRS, Toulouse

**Pause — Break**

**15h30**

- Electromagnétisme et structures multi-échelles  
*Electromagnetism and multiscale structures*  
Hervé Aubert, LAAS-CNRS, Toulouse
- L'électronique RF imprimée sur papier par jet d'encre : la solution pour l'acquisition de données et le calcul ubiquitaires ?  
*Inkjet-Printed paper-based RF electronics: the solution for ubiquitous sensing and pervasive computing?*  
Manos Tentzeris, Georgia Institute of Technology, Atlanta, USA
- Etat de l'art et tendances des dispositifs semiconducteurs de puissance pour une gestion optimisée de l'énergie  
*State of the art and trends in power semiconductor devices for optimized power management*  
Frédéric Morancho, LAAS-CNRS, Toulouse

**Cocktail**

**18h15**

Accueil — *Welcome*

8h30

**Modélisation, optimisation et conduite des systèmes 9h-12h30**  
***Modeling, Optimization & Control of Systems***

- Principales avancées en théorie de la commande  
*Major advances in control theory*  
Germain Garcia, LAAS-CNRS, Toulouse
- Amélioration de l'efficacité et réduction de la pollution par modélisation et contrôle des instabilités de combustion  
*Improving efficiency and reducing pollution by modeling and control of combustion instabilities*  
Ioan Landau, GIPSAlab, Dépt d'Automatique, Grenoble

**Pause — *Break***

**10h30**

- Réseaux d'ordinateurs et G-réseaux  
*Computer networks and G-networks*  
Erol Gelenbe, Imperial College London, Royaume-Uni
- Modélisation et commande de réseaux de télécommunication à large échelle  
*Modeling and control of large scale telecommunication networks*  
Jean-Marie Garcia, LAAS-CNRS, Toulouse

**Déjeuner — *Lunch***

**12h30**

Accueil — *Welcome*

13h30

**Table ronde — Panel**

**14h-15h30**

**40 ans de partenariat recherche-industrie privilégié**  
**40 years of privileged research-industry partnership**

Animée par Jean-Jacques Rouch, Journaliste à La Dépêche du Midi

- Denis Blanc (Freescale)
- Jean-Frédéric Clerc (CEA)
- Christian Desmoulins (Actia Group)
- Philippe Desroches (Continental Automotive)
- Alain Duprey (Association des Instituts Carnot)
- Jean-Max Gaubert (AREVA TA)
- Alain Jullien (Alstom)
- Laurent Maniscalco (Kineo)
- Pierre Montoriol (Hemodia)
- Denis Ribot (Airbus)
- Jean-Louis Sanchez (LAAS-CNRS)

Pause — *Break*

15h30

**Table ronde — Panel**

**16h-17h30**

**Célébration du 40<sup>e</sup> anniversaire**  
**Celebration of the 40<sup>th</sup> anniversary**

Animée par Jean-Christophe Giesbert, Directeur de la Rédaction de La Dépêche du Midi

- Raja Chatila, Directeur du LAAS-CNRS
- Jacques Erschler, Président du PRES Université de Toulouse
- Louis Laurent, Responsable du département Sciences et Techniques de l'information et de la Communication de l'ANR
- Pierre Guillon, Directeur du département des Sciences et Technologies de l'Information et de l'Ingénierie du CNRS
- Pierre Cohen, Maire de Toulouse, Président de la Communauté d'Agglomération du Grand Toulouse
- Pierre Izard, Président du Conseil Général de la Haute-Garonne
- Martin Malvy, Président du Conseil Régional Midi-Pyrénées
- Olivier Dugrip, Recteur de l'Académie de Toulouse, Chancelier des Universités
- Dominique Bur, Préfet de la Région Midi-Pyrénées

**Cocktail**

17h30

Accueil — *Welcome*

8h30

## **Systèmes informatiques critiques** **Critical Information Systems**

**9h-12h30**

- De la sûreté de fonctionnement à la résilience  
*From dependability to resilience*  
Jean-Claude Laprie, LAAS-CNRS, Toulouse
- De l'évolution des menaces : à qui la faute ?  
*On the evolution of threats: who is faulty?*  
Marc Dacier, Symantec Research Labs Europe, Sophia Antipolis

**Pause — Break**

**10h30**

- Conception et vérification de logiciels pour le temps réel et la communication  
*Design and verification of real-time and communicating software*  
Michel Diaz, LAAS-CNRS, Toulouse
- Test de logiciels et de systèmes de communication  
*Testing of software and of communication systems*  
Richard Castanet, LaBRI, Bordeaux

**Déjeuner — Lunch**

**12h30**

Accueil — *Welcome*

**13h30**

## **Robotique et intelligence artificielle** **Robotics and Artificial Intelligence**

**14h-17h30**

- Bases mathématiques du mouvement en robotique  
*Mathematical foundations of robot motion*  
Jean-Paul Laumond, LAAS-CNRS, Toulouse
- La robotique au service de l'Homme  
*Human-centered robotics*  
Oussama Khatib, Stanford University, CA, USA

**Pause — Break**

**15h30**

- Mieux vivre avec les robots  
*Living Better with Robots*  
Cynthia Breazeal, MIT Media Lab, Cambridge, MA, USA
- Questions pour un robot coopératif : quoi, qui, où, quand, comment ?  
*Questions for a cooperative robot: what, who, where, when, how?*  
Rachid Alami, LAAS-CNRS, Toulouse

**Cocktail**

**17h30**

14:00

**Nanofabrication par combinaison :  
nanostructuration et autoassemblage**  
*Combinational nanofabrication: nanopatterning  
and self-assembly*

**Clivia Sotomayor**, Catalan Institute  
of Nanotechnology (ICN-CIN2), Barcelone, Espagne



Mardi 7 octobre

In the context of information and communication technologies self-assembly and nanopatterning technologies meet to facilitate novel functions on Silicon platforms under the umbrella of heterogeneous integration.

It is commonly assumed that self-assembly of mesoscopic, nanoscopic and molecular entities is by definition cost-effective compared to other nanofabrication methods. However, as with any technology, quantitative methods are required to extract ordering parameters. Here we present a way to obtain crystal ordering in the plane and in the bulk by applying acoustic fields during vertical drawing crystallisation of colloidal mesoscopic and nanoparticles. This spatially coherence resonance-like behaviour in the self-assembly of three-dimensional fcc colloidal crystals results in an improvement of a factor of 10 of the in-plane crystallinity. The process is akin to stochastic resonances. The quantitative analysis is a generic approach to quantify crystal using discrete Fourier Transform analysis of the scanning electron micrograph or AFM images. This approach can be extended to quantify ordering of other self-organised structures, such as micells or self-organised quantum dots. Our study covered also the 3-dimensional ordering of these structures by transmission spectroscopy. We thus have tested a quantitative approach to self-assembly characterisation thereby bringing it closer to metrics and standards, which are a prerequisite for uptake in future applications, such as those in biotechnology.

**Clivia M. Sotomayor Torres** obtained her BSc. (Hons.) Physics in 1979 (Southampton University, UK) and her Dr. Phil. in Physics in 1984 (Manchester University, UK). She has held academic appointments at the Universities of St. Andrews and Glasgow (UK), a chair at Wuppertal University (Germany) and a research professorship at Univesity College Cork (Ireland). Clivia has received three prestigious awards from the Royal Society of Edinburgh, the Nuffield Foundation, and a ZONTA Amelia Earhart Fellowship (USA) in 1993, 1990 and 1982, respectively. Her research interests include the science and engineering of optical nanostructures, nanoimprint lithography, light propagation and emission in periodic and quasi-periodic media, inorganic nanotubes and more recently confined phonons in silicon-on-insulator thin films and membranes. Since May 2007 she is an ICREA Research Professor at the Catalan Institute of Nanotechnology (ICN-CIN2) in Spain, where she has built a group to investigate phonons in low dimensional systems, develop nanofabrication methods for 3D structuring and carry out research in dispersion engineering.

She has authored over 350 scientific papers and edited six books, including *Alternative Lithography: unleashing the power of Nanotechnology* published by Kluwer-Academic-Plenum in 2003.

Since 1989 she has participated in several EU projects as partner and coordinator. Her team currently participates in STABILIGHT, NANOPACK, NAPANIL and NANOICT. She coordinates the IST Network of Excellence "Nanophotonics to realise molecular-scale technologies" PHOREMOST.

**14:45** Micro et nanotechnologies au service  
des sciences du vivant et de la médecine  
*Micro and nanotechnologies for life sciences  
and medicine*

**Christophe Vieu**, LAAS-CNRS, Toulouse



**Mardi 7 octobre**

Through the miniaturization down to the molecular scale, the fabrication of innovative devices, systems and chips dedicated to medical applications becomes possible. The expectations are very high in terms of diagnosis at the early stage of a disease, for new therapies and for increasing the capabilities of medical imagery. Another aspect which is less visible concerns the acquisition of new knowledge in biology at the cellular and sub-cellular levels which can strongly impact the progresses for curing severe and complex diseases such as cancer. Indeed, through the micro and nanotechnologies the manipulation and observation of DNA, proteins and cells, allow for novel experiments to be conducted in the perspective of investigating, in a new way, basic fundamental mechanisms of biology. In this presentation, I will present the benefits of developing Micro and Nanoscale technologies in the field of biology and medicine. I will rapidly present the landscape of what is called today nano-medicine. I will then illustrate this scientific challenge through the presentation of several projects running in the Nanobiosystem research group at LAAS-CNRS and on the basis of major achievements obtained around the world.

**Christophe Vieu**, PhD in solid state physics is Professor of Physics at the National Institute of Applied Sciences (INSA), an Engineering School in Toulouse. He is conducting research in the field of Nanobiotechnologies at LAAS-CNRS. His main fields of interests are : Nanopatterning, Biopatterning, Nanoscale devices and tools for biodetection and medicine, education in Nanotechnologies. Author or coauthor of more than 130 publications in international conference proceedings, journals and books, he has been involved in several European projects.



**16:00** **Electromagnétisme et structures multi-échelles**  
*Electromagnetism and multiscale structures*

**Hervé Aubert**, LAAS-CNRS, Toulouse



**Mardi 7 octobre**

An efficient monolithic (unique) formulation for the electromagnetic modeling of multiscale structures, i.e., structures that exhibit multiple metallic patterns whose sizes cover a large range of scales, will be presented. Examples of multi-scale structures are given by multi-band frequency-selective surfaces, active or passive reflectarrays, or self-similar (pre-fractal) planar objects. Applying to such complex structures available full-wave electromagnetic simulations requires prohibitive execution time and memory resources. The electromagnetic simulation of multi-scale structures may be performed by the combination or hybridization of various numerical techniques, each technique being the most appropriate for each particular scale level. However such coupling between heterogeneous formulations or the interconnection of various simulation tools is very delicate in practice. In order to overcome these theoretical and practical difficulties, an original monolithic (unique) formulation is proposed here for the electromagnetic modeling of multi-scale structures. This new approach, named the Scale Changing Technique, is based on the cascade of multi-modal Scale Changing Networks, each network modeling the electromagnetic coupling between two successive scale levels. Recent applications of this technique to the design and electromagnetic simulation of active planar phase-shifters, pre-fractal scatterers and multi-frequency selective surfaces will be shown and discussed.

**Hervé Aubert** was born in Toulouse, France, in July 1966. He received the Eng. Dipl. in July 1989 and the Ph.D. degree in January 1993, both in Electrical Engineering and both from the Institut National Polytechnique (INPT), Toulouse, France. In January 1993 he joined the faculty of INPT and became Professor in February 2001. From April 1997 to March 1998 he was a Visiting Associate Professor at the School of Engineering and Applied Science, University of Pennsylvania (UPenn), Philadelphia, USA, and was a Visiting Scholar at UPenn from June 15, 2004 to July 31, 2004.

From 2001 to 2005, Dr. Aubert was the Associate Chairman of the Electronics Laboratory at Ecole Nationale Supérieure d'Electronique, d'Electrotechnique, d'Informatique, d'Hydraulique et des Télécommunications (ENSEEIH), Toulouse, and additionally, he was the Head of the Electromagnetism Research Group in this Laboratory (2002–2005). He has joined LAAS-CNRS in February 2006.

Dr. Aubert has performed research work on integral-equation and variational methods applied to electromagnetic wave propagation and scattering. Currently his research activities involve the electromagnetic modelling of complex (multi-scale) structures.

16:45

L'électronique RF imprimée sur papier par jet d'encre : la solution pour l'acquisition de données et le calcul ubiquitaires ?  
*Inkjet-Printed paper-based RF electronics: the solution for ubiquitous sensing and pervasive computing?*



**Manos Tentzeris**, Georgia Institute of Technology, Atlanta, USA

Mardi 7 octobre

In this talk, inkjet-printed flexible antennas fabricated on paper substrates are introduced as a system-level solution for ultra-low-cost mass production of UHF Radio Frequency Identification (RFID) Tags and Wireless Sensor Nodes (WSN) in an approach that could be easily extended to other microwave and wireless applications. A compact inkjet-printed UHF "passive-RFID" antenna using the classic T-match approach and designed to match IC's complex impedance, is presented as a demonstrating prototype for this technology. In addition, we briefly touch up the state-of-the-art area of fully-integrated wireless sensor modules on paper and show the first ever 2D sensor integration with an RFID tag module on paper, as well as the possibility of a 3D multilayer paper-based RF/microwave module, that could potentially set the foundation for the truly convergent wireless sensor ad-hoc networks of the future.

**Manos M. Tentzeris** received the Diploma Degree in ECE from the National Technical University of Athens, Greece and the M.S./Ph.D. degrees in ECE from the University of Michigan and he is currently an Associate Professor with School of ECE, Georgia Tech. He has published more than 300 refereed papers, 2 books and 15 book chapters. He is the Georgia Electronic Design Center Associate Director for RFID/Sensors research, and he has been the GT NSF-Packaging Research Center Associate Director for RF Research from 2003-2006. He has been the recipient of numerous awards including the 2007 IEEE APS Best Student Paper Award, the 2006 IEEE MTT Outstanding Young Engineer Award, the 2006 Asian-Pacific Microwave Conference Award, the 2004 IEEE Transactions on Advanced Packaging Commendable Paper Award, the 2003 NASA Godfrey "Art" Anzic Collaborative Distinguished Publication Award, the 2003 IEEE CPMT Outstanding Young Engineer Award, the 2002 International Conference on Microwave and Millimeter-Wave Technology Best Paper Award (Beijing, China), the 2002 Georgia Tech-ECE Outstanding Junior Faculty Award and the 2000 NSF CAREER Award. He was the TPC Chair for IEEE IMS 2008 Symposium. He is the Associate Editor of IEEE T-Advanced Packaging and of IEEE T-MTT. He was a Visiting Professor with the Technical University of Munich in 2002 and he has given more than 50 invited talks. He is a Senior Member of IEEE, a member of URSI-Commission D, a member of MTT-15, an Associate Member of EuMA, a Fellow of the Electromagnetic Academy and a member of the Technical Chamber of Greece.

17:30

Etat de l'art et tendances des dispositifs  
semiconducteurs de puissance pour une  
gestion optimisée de l'énergie  
*State of the art trends in power semiconductor  
devices for optimized power management*

**Frédéric Morancho**, LAAS-CNRS, Toulouse



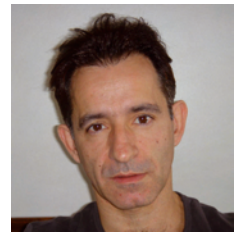
Mardi 7 octobre

This presentation reviews the current status of power semiconductor devices and technologies and discusses new trends in this field. It will first focus on novel concepts of silicon power devices such as MOSFETs and IGBTs which play an increasing role in the realisation of optimized power systems. Then, the recent progresses in the development of high-voltage wide band-gap (SiC, GaN and diamond) power devices will be reviewed. The talk will end with an overview of the performance of silicon and wide band-gap power devices with respect to the "specific on-resistance/breakdown voltage" trade-off.

**Frédéric Morancho** was born in Toulouse, France, in 1969. He received his Master degree and his Ph.D. degree in Microelectronics Engineering from the University Paul Sabatier of Toulouse, France, in 1992 and 1996, respectively.

Since 1997, he is Assistant Professor with the "Université de Toulouse" (Université Paul Sabatier) and Research Scientist at LAAS-CNRS in the "Integration of Systems for Energy Management" group (ISGE). In this group, he has led the "New power devices" team since 2000. His research interests include modeling, design, realization and characterization of silicon unipolar power devices, topics on which he has published more than 50 papers (2 books, 4 patents, 17 papers in international scientific journals, 38 papers in international conferences). He has worked on the modeling of VDMOSFETs and vertical trench MOSFETs, and on the design and technological realization of novel concepts of devices such as lateral trench MOSFETs (LUDMOSFETs), floating islands MOSFETs (FLIMOSFETs) and Deep Trench SuperJunction MOSFETs (DT-SJMOSFETs). Recently, he has started in parallel a new research activity dedicated to gallium nitride (GaN) power devices.

**09:00** Principales avancées en théorie de la commande  
*Major advances in control theory*  
**Germain Garcia**, LAAS-CNRS, Toulouse



**Mercredi 8 octobre**

In this presentation, we develop the main lines of the research activities on control theory carried out at LAAS-CNRS, since its creation in 1968. While this presentation is by no means exhaustive, we detail the principal contributions, related for some of them, to the main Kalman's contributions published in the sixties on state space control design theory. We explain how the developments of informatics on the one hand, and spatial and aeronautical applications on the other hand, have influenced the research work conducted at LAAS in the domain of control theory design during the past years.

To illustrate their national and international impacts, we present the main philosophy and contributions in the domains of:

- Robust control,
- Control with limited actuators or sensors,
- Numerical methods for control design.

We end the presentation by providing some perspectives describing the recent orientations of the works in control theory and their relationship with some advances in related domains.

**Germain Garcia** graduated from the Engineering School INSA of Toulouse (INSAT) and obtained his "Habilitation à Diriger des Recherches" from University Paul Sabatier in Toulouse in 1997. He is currently Professor in the Department of Electrical Engineering and Computer Science department at INSAT and a member of the research group "Methods and Algorithms in Control" at LAAS-CNRS. His fields of interest are related to robust control and control of systems with bounded inputs. He published more than 150 journal and conference papers. From 2003 to 2006, he was Assistant Director of LAAS-CNRS, responsible of the Area "Modeling, Optimization and Control of Systems". He was or is involved in several international working groups (UECA, IFAC and IEEE).

09:45

Amélioration de l'efficacité et réduction de la pollution par modélisation et contrôle des instabilités de combustion  
*Improving efficiency and reducing pollution by modeling and control of combustion instabilities*

**Ioan Landau**, GIPSA-lab, Dépt. d'Automatique, Grenoble



Mercredi 8 octobre

Operation at low fuel-to-air ratio in turbo-machinery, such as gas-turbine power plants and jet engines is desirable from an economic and environmental perspective. Unfortunately combustion instabilities arise in this regime. There is a strong tendency to try to eliminate these instabilities through control.

A control model for combustion instabilities issued from an experimental work on gas turbine done jointly by Univ. of California, San Diego and United Technologies will be presented. The objectives of the talk are:

- 1) To demonstrate analytically (using Krylov-Bogoliubov methods) that this model is able to reproduce the experimentally observed phenomena and in particular the simultaneous coexistence of two non-harmonic oscillatory modes
- 2) To show that the model can be used for the analytical design of feedback quenching strategies using fuel flow modulation as a multiplicative control input.

**Ioan Doré Landau** is Emeritus Research Director at CNRS and works at GIPSA-Lab, Control Dept. (CNRS/INP Grenoble).

His research interests encompass theory and applications in system identification, adaptive control, robust digital control and nonlinear systems. He has authored and co-authored over 200 papers on these subjects. He is the author or co-author of several books including: *Adaptive Control - The Model Reference Approach* (Dekker 1979) and *Digital Control Systems – design, identification and implementation* (Hermès 2002, Springer 2005).

Dr. Landau received the Rufus Oldenburger Medal 2000 from the American Society of Mechanical Engineering. He is "Doctor Honoris Causa" of the Université Catholique de Louvain-la-Neuve (2003). He was a R. Springer Professor at the University of California, Berkeley (1992). He received the price Monpetit from the French Academy of Science (1991), the "Best Review Paper Award (1981-84)" from ASME Journal of Dynamical Systems Measurement and Control, the CNRS Silver Medal in 1982 and the Great Gold Medal at the Invention Exhibition Vienna in 1968. He was an IEEE-CSS "Distinguished Lecturer" (2001-2003) and has been appointed "IFAC Fellow" in 2007

At CNRS, he was the Director of several co-ordinated research programs and Director of the Laboratoire d'Automatique de Grenoble from 1987 to 1990. Dr. Landau was the first President of the European Union Control Association (EUCA) and Editor in Chief of the European Journal of Control from 1994 to 2003.

11:00 Réseaux d'ordinateurs et G-réseaux  
*Computer networks and G-networks*

**Erol Gelenbe**, Imperial College London,  
Royaume-Uni



Mercredi 8 octobre

Chemical reaction networks, Ising-type models in physics, neuronal circuits, gene regulatory networks, electronic circuits, economic markets, and computer networks are all instances of «networked systems». They are often considered as stochastic networks, even in the case of electronic circuits when their components and connections are «ultra small», or unreliable, or when they are noisy. In a series of papers which have recently appeared in journals of physics, biology, computational neuroscience, and Internet technology, we address the dynamics of such systems in a unified manner through their «master equations», also known in mathematics as instances of Chapman-Kolmogorov equations, using the theory of «G-networks» which we have developed for queueing networks. In this talk, we introduce these models with the example of spiked neuronal networks, which we then illustrate through applications to cortico-thalamic sensory circuits, to network routing and also image processing. A similar approach will then be applied to gene regulatory networks and to the analysis of chemical reactions. Finally, we will show that the price equilibrium in a network of auctions can be studied using similar methods.

**Erol Gelenbe** is the Dennis Gabor Professor and Head of Intelligent Systems and Networks in the Electrical and Electronic Engineering Department at Imperial College. Prior to Imperial, he was the Associate Dean of Engineering and founding Director of the School of Electrical Engineering and Computer Science at the University of Central Florida. Prior to that at Duke University, he was the Nello L. Teer Professor and Head of the Department of Electrical and Computer Engineering, with secondary appointments as Professor of Computer Science and of Experimental Psychology. Before Duke, he was a Professor at the University of Paris and also taught at Ecole Polytechnique (Paris). During his twenty years in France, he founded research groups in “computer and network performance evaluation” at INRIA and throughout French universities, founded several post-graduate programmes, introduced network performance evaluation technology into France Telecom and other ITC companies, and contributed specific methods to commercial performance evaluation software packages such as QNAP2. He was appointed to his first chair at the age of 27 at the University of Liege (Belgium). Erol’s current research projects include distributed system performance, novel “self-aware” computer and sensor networks, and probability models inspired by physics, chemistry, biology and economics. He teaches a course on the performance of distributed systems and networks at the undergraduate and postgraduate levels. Erol is a Fellow of the IEEE, ACM and IET. He is a member of the French National Academy of Engineering, the Academy of Sciences of Turkey and of Academia Europaea. He received the 2008 ACM SIGMETRICS Life-time Achievement Award, the 1996 Grand Prix France Telecom of the French Academy of Sciences and the Parlar Science Award of Turkey in 1994. He was awarded the honors of Doctor Honoris Causa by the University of Roma Tor Vergata, Italy, the University of Liege in Belgium, and Bogazici University in Turkey. The President of Italy awarded him the decorations of Grand Officer of the Order of the Star of Solidarity in 2007 and Commander of Merit in 2005, and France awarded him the Officer of Merit Medal and the Chevalier des Palmes Academiques honor.

**11:45** Modélisation et commande de réseaux de télécommunication à large échelle  
*Modeling and control of large scale telecommunication networks*

**Jean-Marie Garcia**, LAAS-CNRS, Toulouse



**Mercredi 8 octobre**

We witness today the advent of a digital era where the IT and broadband communications create a new economy and shape the behavior of a new society. In this context, fixed and mobile multimedia networks take an unprecedented importance with the convergence of heterogeneous access technologies and the virtualization of services. The control and design of such systems require large scale integrated approaches, spanning from the detailed modeling of stochastic processes, up to resource management and dynamic engineering of networks:

*modeling of subscribers behavior, applications and traffic sources, estimation of traffic matrices, optimization of network topologies, capacity planning, management of the quality of service, design of, static or dynamic, resilient routing policies.*

In this talk, we present a synthesis of some works carried out at LAAS-CNRS on these issues, and in particular, selected contributions related to the techniques of differential and hybrid modeling, queuing networks, mixed non-linear optimization and Metaheuristics.

**Jean-Marie Garcia** has obtained his Engineer degree in 1976 at INSA, Toulouse. He then got a "Master of Applied Sciences" degree from the University of Montreal in 1978, and conducted research activities at Hydro-Québec research center. He obtained his PhD at LAAS in 1980. Then he became in turn research fellow at the University of California, Berkeley, and research associate with France Telecom R&D at CNET. He then joined LAAS as a CNRS research staff member in 1981, where he was successively responsible for the research groups "Parallel Algorithms in Control, Optimisation-Filtering" and "Parallelism and Telecommunication Networks and Systems". Subsequently, he became Scientific Director of the *Delta Partners* company. Since 2004, he is the founding director of the startup company *QoS Design* that was awarded several Innovation prizes. Jean-Marie Garcia is currently a Research Director with CNRS (delegated by CNRS with *QoS Design*).

His research interests encompass stochastic modeling, traffic and queuing theory, telecommunications, optimization and control of large scale systems, scientific computation on clusters and grids. He is the author of more than 100 papers and advised about twenty doctoral theses. He conducted numerous academic and industrial collaborative research projects with telecommunication research centers such as ATT, Vodafone, British Telecom, France Telecom R&D, SFR, as well as with several key players in the field (Alcatel, Nortel, Ericsson...).

**09:00** De la sûreté de fonctionnement à la résilience  
*From dependability to resilience*

**Jean-Claude Laprie**, LAAS-CNRS, Toulouse



**Jeudi 9 octobre**

L'exposé couvre des développements marquants de ces quarante dernières années, l'état de l'art, et les défis ouverts.

Les développements marquants ont trait aux différents moyens pour la sûreté de fonctionnement : tolérance aux fautes, élimination des fautes, prévision des fautes.

L'état de l'art est illustré par les performances statistiques des systèmes en matière de sûreté de fonctionnement. L'état actuel des connaissances permet de raisonnablement maîtriser le développement, le déploiement et l'exploitation de systèmes informatiques critiques. La situation change radicalement pour les grands systèmes émergents, évolutifs, en réseaux fixes ou mobiles, qui préfigurent l'informatique ubiquitaire.

Les défis sont précisément situés dans le contexte des systèmes ubiquitaires, et des tendances lourdes qui se manifestent pour ces systèmes, tels le génie logiciel dynamique et la découverte de services, tendances qui remettent en cause les modèles traditionnels de développement et les approches de protection contre les diverses sources de défaillance, qu'elles soient accidentelles ou malveillantes. Pour ces protections, des approches proactives doivent se substituer, ou à tout le moins compléter les approches réactives classiques.

Développements marquants, état de l'art et défis sont exprimés dans le cadre des concepts de la sûreté de fonctionnement, et par leur évolution via la notion de résilience, permettant d'exprimer les propriétés que devront exhiber les systèmes ubiquitaires du fait de leurs évolutions perpétuelles.

**Jean-Claude Laprie** est Directeur de Recherche de Classe Exceptionnelle au CNRS. Entré au LAAS-CNRS en 1968, il a fondé en 1975 le Groupe de recherche Tolérance aux fautes et Sûreté de Fonctionnement Informatique, qu'il a dirigé jusqu'à fin 1996, lorsqu'il a pris la direction du LAAS, pour 6 ans, jusqu'à fin 2002. Il coordonne actuellement le réseau d'excellence européen ReSIST (Resilience for Survivability in Information Society Technologies).

Ses activités de recherche sont centrées sur la tolérance aux fautes, et sur l'évaluation probabiliste de leur sûreté de fonctionnement, sujets qui ont donné lieu à plus de 100 articles dans des revues et communications à des congrès (dont près du tiers sur invitation), ainsi qu'à plusieurs ouvrages. Il a aussi été très actif dans la formulation des concepts de base de la sûreté de fonctionnement et la terminologie associée ; les vues qu'il a développées sont largement adoptées par la communauté scientifique. L'ensemble de ces activités de recherche a comporté de nombreuses relations avec l'industrie, qui ont culminé avec la fondation en 1992 du LIS (Laboratoire d'Ingénierie de la Sûreté de fonctionnement), laboratoire commun recherche-industrie qu'il a dirigé jusqu'à fin 1996.

Sa forte implication dans la vie de la communauté scientifique internationale va de responsabilités dans des sociétés savantes comme la présidence du Comité Technique Fault Tolerant Computing de l'IEEE Computer Society ou la vice-présidence de l'IFIP (International Federation for Information Processing), à des séjours prolongés dans plusieurs universités (Brésil, Singapour, USA), y compris une année passée à UCLA comme Invited Visiting Professor. Membre ou président des comités de programme de nombreuses conférences internationales, il en a organisé plusieurs, la plus récente étant le 18ème IFIP World Computer Congress (Toulouse, août 2004).

Il a reçu la Médaille d'Argent de la recherche scientifique française en 1993, et a été fait Chevalier de l'Ordre National du Mérite en 2002.



**09:45** De l'évolution des menaces : à qui la faute ?  
*On the evolution of threats: who is faulty?*

**Marc Dacier**, Symantec Research Labs Europe,  
Sophia Antipolis



**Jeudi 9 octobre**

November 2nd, 2008, will mark the 20th anniversary of the appearance of the first computer worm able to spread quickly and widely all over the Internet: the Internet worm, also known as the Morris Worm. This is probably a good time to briefly recap the observed evolution of the Internet threats since that date. We will see that the most recent trends seem to indicate the existence of a professional underground market to sell or rent malicious services and tools. In parallel, we will see how solutions have evolved with respect to the arising threats. We will present the classical intrusion detection and prevention systems and position them in the broader context of dependability mechanisms. We will review the problem of assessing the efficiency of these solutions and we will show, based on experimental results, how difficult benchmarking these tools can be. Last, we will try to understand why, twenty years after the Morris Worm, we have apparently failed in solving the Internet security issues. We will conclude by offering avenues for future work as well as perspectives on potential new threats.

**Marc Dacier** joined Symantec as the director of Symantec Research Labs Europe in April 2008. From 2002 until 2008, he was a Professor at the Eurecom Institute, France. From 1996 until 2002, he worked at IBM Research as the manager of the Global Security Analysis Lab. (GSAL). He obtained an IBM Outstanding Technical Achievement Award for his contribution to the business of IBM Global Services. Also, the GSAL team pursued several projects in the intrusion detection domain which led to the creation of the Tivoli Risk Manager product.

In 1995, he worked within France Telecom as an external consultant in charge of security for the organization responsible for the strategy of the IT infrastructure. From 1992 until 1994, he was a member of the Dependability group, at LAAS-CNRS, working on quantitative evaluation of operational computer security and obtained his PhD there from the Toulouse National Polytechnic Institute. From 1989 until 1991, he was with the University of Louvain.

Since 1997, he has been giving, as an invited researcher, an intrusion detection seminar at the University of Louvain (UCL), Namur (FUNDP) and Liège (ULG) and also at the ENSEEIHT in Toulouse. In 2002, he has received the title of invited professor at UCL and associate professor at ULG.

In 1998, he co-founded with K. Jackson the "Recent Advances on Intrusion Detection" Symposium (RAID). He is now chairing its steering committee. He has served in more than 60 program committees of major security and dependability conferences and is a member of the steering committee of the "European Symposium on Research for Computer Security" (ESORICS).

He was a member of the editorial board of the following journals: IEEE TDSC, ACM TISSEC and JIAS.

**11:00** Conception et vérification de logiciels  
pour le temps réel et la communication  
*Design and verification of real-time  
and communicating software*

**Michel Diaz**, LAAS-CNRS, Toulouse



**Jeudi 9 octobre**

The current global approaches that are used to design present complex systems are based on two different and complementary principles, and the resulting design methodologies respectively lead to the definition of Embedded Systems and Internet Systems.

On one hand, embedded systems, having different strong constraints and real-time requirements, are developed starting from formal techniques, in order to allow the designers to specify the system, build a understandable model, and use it to check and validate as early as possible the design process and the system behavior. On the other hand, Internet systems, highly distributed, fully open, featuring a hierarchy of networks and protocols, with mobile and dynamic characteristics, lead to very sophisticated designs, with a set of different layers, that result in best-effort architectures.

This talk will first discuss these two families of systems, describe the main current design problems, and present some related methodological solutions. It will then discuss what would be the main interests and properties of a next generation of systems that should be able to integrate these two areas. Finally, it will propose some research topics that should be developed in order to design this important and future generation of advanced systems.

**Michel Diaz** is Director of Research with CNRS, working on the development of formal methodologies, techniques and tools for designing multimedia distributed systems. He was the manager of the EC ESPRIT SEDOS project on the development of formal description techniques. He headed the CNET-CNRS project CESAME on the formal design of high speed multimedia cooperative systems and the French TOPASE project on Distributed Multimedia Professional teaching. He was co-ordinator in the EC programme IST of the European project GCAP on new architecture for active multicast multimedia end-to-end protocols for the internet. In 1989 and 1990, he spent a year as a visiting professor and senior researcher at the University of Delaware at Newark and at the University of California at Berkeley. He was a member of the Advisory Board on the future of the Internet at the EC and of the future of the French national research computer network Renater. He was member of the Board of Directors at LAAS, leading the Research Area "Critical Information Systems", Director of the French Research on "Architecture, Networks, Systems and Parallelism", and he is now in charge for the CNRS of co-ordinating the French research groups of Experts on Communication Networks. He served as Chairman or member of many Program Committees. He is expert for many European and French Research Programmes. He has written more than 200 technical publications, one book, and is the editor or co-editor of 12 North Holland, Springer World Scientific, ARAGO and Hermes books. He is a recipient of the IFIP Silver Core, Senior Member of the IEEE, member of the New York Academy of Sciences and is listed in the Who's Who in Science and Engineering.

**11:45** Test de logiciels et de systèmes de communication  
*Testing of software and of communication systems*

**Richard Castanet**, LaBRI, Bordeaux



**Jeudi 9 octobre**

Testing is a very important matter in the life-cycle of software. It represents a validation technique to increase the level of confidence in the software. Several standards related to testing have been proposed for the protocols and industrial systems. We distinguish different types of tests: conformity, interoperability, robustness, performance, non regression. In a number of cases, the time devoted to testing may be greater than 50% of the life cycle. It is therefore necessary to develop methods and tools to reduce this time. The use of a formal specification is very effective and interesting. It allows for use several types of validation tools to be used: formal verification, simulation, proof and often the automatic generation of executable code and the automatic generation of test sequences. In the talk, we will focus on the case of communication protocols and reactive embedded systems using, as formal models, transition systems and their extensions (with variables, predicates, clocks, time...). Furthermore, testing architectures are required in order to ensure a degree of controllability and observability.

The problems of the testing and the generation of test sequences are related to the test coverage, reducing the number of tests (and therefore the time spent on testing), reducing the size of tests and architectures.

**Richard Castanet** is Professor at the University of Bordeaux, more precisely in the graduate school of engineering ENSEIRB and leads the research team LSR (Languages, Systems and Networks) at LaBRI (Research Laboratory in Computer Science of Bordeaux). He is also Director of the graduate school of engineering ENSEIRB and has led the LaBRI from 1999 to 2003. His main research interests are formal specification, testing (conformance, interoperability, robustness) of reactive or embedded systems or communication protocols, and automatic generation of tests. He is author or co-author of more than 100 papers in scientific journals or in international conferences. He has led industries-research projects between LaBRI and several major companies (BULL, France Telecom, IBM, Electricité de France, Airbus, RATP). He participates or has participated to several national projects (RNTL, RNRT, ANR, specific actions CNRS) and European projects in the domain of testing of software or of communication protocols.

# 14:00 Bases mathématiques du mouvement en robotique

## *Mathematical foundations of robot motion*

**Jean-Paul Laumond**, LAAS-CNRS, Toulouse



**Jeudi 9 octobre**

Robot Motion Planning is an active research area in Robotics for almost 30 years. A geometric model of the environment being given, the goal is to provide a mechanical system with the capacity of computing motion strategies to avoid the obstacles in an autonomous way. The problem of moving a mechanical system made of 3-dimensional bodies can be formulated as the problem of moving a point in the so-called system configuration space. This statement, borrowed from Mechanics, reduces the motion planning problem to the search of connected components in the collision-free configuration space.

How to transform this continuous problem into a combinatorial one?

The talk will give an overview of the relevant mathematical approaches ranging from algebraic geometry to differential geometry via discrete geometry. Successful results will be illustrated in areas of robot programming, mobile robots, and beyond Robotics in Product Lifecycle Management or molecular modeling.

After presenting some challenging open mathematical problems in robot motion planning, the talk will conclude on a current opening of robot motion studies towards neurosciences.

**Jean-Paul Laumond** is Director of Research at LAAS-CNRS. He received the M.S. degree in Mathematics, the Ph.D. in Robotics and the Habilitation from the University Paul Sabatier at Toulouse in 1976, 1984 and 1989, respectively. From 1976 to 1983 he was teacher in Mathematics. He joined CNRS in 1985. In Fall 1990 he has been an invited senior scientist at Stanford University. He has been a member of the French *Comité National de la Recherche Scientifique* from 1991 to 1995. He is currently co-director of the French-Japanese AIST-CNRS laboratory JRL on Humanoid Robotics.

From 1992 to 1995, he has been coordinator of two the European ESPRIT projects PROMotion (Planning Robot Motion, 1992-1995) and MOLOG (Motion for Logistics, 1999 - 2002), both dedicated to robot motion planning technology. In 2001 and 2002 he created and managed Kineo CAM, a spin-off company from LAAS-CNRS, devoted to develop and market motion planning technology. Kineo CAM was awarded the French Research Ministry prize for innovation and enterprise in 2000 and the IEEE-IFR prize for Innovation and Entrepreneurship in Robotics and Automation in 2005.

His current research is devoted to human motion studies along three perspectives: artificial motion for humanoid robots, virtual motion for digital actors and mannequins, and natural motion of human beings.

He teaches Robotics at ENSTA and Ecole Normale Supérieure in Paris. He has edited three books. He has published more than 100 papers in international journals and conferences in Computer Science, Automatic Control, Robotics, recently including Neuroscience. He is IEEE Fellow, IEEE Distinguished Lecturer, Editor of the IEEE Transactions on Robotics and member of the IEEE RAS AdCom.

14:45 La robotique au service de l'Homme

*Human-centered robotics*

**Oussama Khatib**, Stanford University, CA, USA



Jeudi 9 octobre

Robotics is rapidly expanding into human environments and vigorously engaged in its new emerging challenges. Interacting and working with humans, the new generation of robots will increasingly touch people and their lives. The successful introduction of robots in human environments will rely on the development of competent and practical systems that are dependable, safe, and easy to use. This presentation focuses on our ongoing effort to develop human-friendly robotic systems that combine the essential characteristics of safety, human-compatibility, and performance. In the area of human-friendly robot design, we present new design concepts for the development of intrinsically safe robotic systems that possess the requisite capabilities and performance to interact and work with humans. Our study of human-motion brought together models from robotics and biomechanics to develop efficient models of human musculoskeletal dynamics and used extensive experimental studies of human subjects. The results of this investigation revealed the dominant role human physiology plays in shaping human motion and provided the fundamental characteristics to effectively encode some basic human motion behaviors. To implement these behaviors on robots with complex human-like structures, we developed a whole-body task-oriented control architecture that addresses dynamics in the context of multiple tasks, multi-point contacts, and multiple constraints. The performance and effectiveness of the new framework are demonstrated through extensive robot dynamic simulations and implementations on physical robots.

**Oussama Khatib** received his Doctorate degree in Electrical Engineering from Sup'Aero, Toulouse, France, in 1980. He is Professor of Computer Science at Stanford University. His current research, which focuses on human-centered robotics, is concerned with human motion synthesis, humanoid robotics, haptic teleoperation, medical robotics, and human-friendly robot design. His research in these areas builds on a large body of studies he pursued over the past 25 years and published in over 200 contributions. Professor Khatib has delivered over 50 keynote presentations and several hundreds of colloquia and seminars at institutions around the world. He served as the Director of the Stanford Computer Forum, a corporate affiliate program. He is Co-Editor of the STAR series, the Springer Handbook of Robotics, and has served on the Advisory and Editorial Boards of prestigious institutions and journals, as well as Chair or Co-Chair for numerous international conferences. He is a Fellow of IEEE and has served RAS as a Distinguished Lecturer and as a member of the Administrative Committee. Professor Khatib is the President of the International Foundation of Robotics Research (IFRR) and a recipient of the Japan Robot Association (JARA) Award in Research and Development.

16:00 Mieux vivre avec les robots

*Living Better with Robots*

**Cynthia Breazeal**, MIT Media Lab, Cambridge,  
MA, USA



Jeu*di* 9 octobre

The emerging field of Human-Robot Interaction is undergoing rapid growth, motivated by important societal challenges and new applications for personal robotic technologies for the general public. In this talk, I highlight several projects from my research group to illustrate recent research trends to develop socially interactive robots that work and learn with people as partners. An important goal of this work is to use interactive robots as a scientific tool to understand human behavior, to explore the role of physical embodiment in interactive technology, and to use these insights to design robotic technologies that can enhance human performance and quality of life. Throughout the talk I will connect HRI research goals to specific applications in healthcare, education, and communication.

**Cynthia Breazeal** is an Associate Professor of Media Arts and Sciences at the Massachusetts Institute of Technology where she founded and directs the Personal Robots Group at the Media Lab. She is a pioneer of Social Robotics and Human Robot Interaction (HRI). Her research program focuses on developing personal robots that interact with humans in human-centric terms, work with humans as partners, and learn from people via tutelage. More recent work investigates the impact of long term HRI applied to communication, quality of life, health, and educational goals. She has authored the book "Designing Sociable Robots" and has published over 100 peer-reviewed articles in autonomous robotics, artificial intelligence, HRI, and robot learning. She has been awarded an ONR Young Investigator Award, honored as finalist in the National Design Awards in Communication, and recognized as a prominent young innovator by the National Academy of Engineering's Gilbreth Lecture Award. She received her Sc.D. in Electrical Engineering and Computer Science from MIT in 2000.

16:45

Questions pour un robot coopératif :  
quoi, qui, où, quand, comment ?  
*Questions for a cooperative robot: what, who,  
where, when, how?*

**Rachid Alami**, LAAS-CNRS, Toulouse



Jeudi 9 octobre

Most robots have to cooperate. This is true in multi-robot systems and also for contexts where a robot has to act in presence or in synergy with humans.

We will discuss a number of problems that such robots have to deal with when confronted to questions such as what action to perform, who will perform it, who will it concern, and also where, when and how the action should be carried out. I will pick some examples from various contexts and show how they gave birth to interesting research topics on control architectures, as well as on task and motion planning.

**Rachid Alami** is a Senior Scientist at LAAS-CNRS. He obtained an engineer degree in Computer Science in 1978 from ENSEEIHT, and a Ph.D in Robotics in 1983 from University Paul Sabatier in Toulouse. He received his *Habilitation à Diriger les Recherches* in 1996. He contributed and took important responsibilities in several national, European and international research and/or collaborative projects (EUREKA: FAMOS, AMR and I-ARES projects, ESPRIT: MARTHA, PROMotion, ECLA, IST: COMETS, COGNIRON, France: ARA, VAP-RISP for planetary rovers, PROMIP). His is involved in several FP6/FP7 IST projects as well ANR projects. His main research contributions concern the fields of robot architectures, task and motion planning, multi-robot cooperation, and human-robot interaction.

■ Le LAAS est un laboratoire de recherche du CNRS (Département ST2I) dans le domaine des Sciences et Technologies de l'Information, de la Communication et des Systèmes.

Il est associé à trois établissements d'enseignement supérieur de l'Université de Toulouse : l'Université Paul Sabatier, l'Institut National des Sciences Appliquées et l'Institut National Polytechnique de Toulouse. Il a reçu le label Carnot en 2006.

Il regroupe 620 personnes, dont près de 250 chercheurs et enseignants-chercheurs, autant de doctorants et post-doctorants, et plus de 100 ingénieurs, techniciens et personnels administratifs.

Ses thématiques menées par 18 groupes de recherche couvrent les pôles suivants :

- Micro et Nano Systèmes (MINAS)
- Modélisation, Optimisation et Conduite des Systèmes (MOCOSY)
- Robotique et Intelligence Artificielle (RIA)
- Systèmes Informatiques Critiques (SINC)

■ *LAAS is a laboratory of the French National Center for Scientific Research (CNRS), within the department of Information and Engineering Sciences and Technologies.*

*It is associated to the Institutes of the University of Toulouse: Université Paul Sabatier, Institut National des Sciences Appliquées and Institut National Polytechnique. The lab has been labelled «Carnot Institute» in 2006.*

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- *Critical Information Systems (SINC)*



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