Scientific Report 2012

Summary

Foreword

This activity report covers the period 2010-2011. Staff lists correspond to the permanent and temporary staffs which was present in the laboratory as of December 31st, 2011. Likewise the scientific publications correspond to this two-year period.

Graduate Schools

- EDIPS: ED 427, Computer Science School (U-PSud)
- Matière Condensée et Interfaces: ED 518 Univ. Paris-Diderot (ex ED Phys. Macroscopique)
- MIPEGE: ED534, Modelisation et Instrumentation en Physique, Energies, Geosciences et Environnement (U-PSud)
- MSTIC: ED532 Mathématiques et STIC (University Paris-Est and Marne-la-Vallée - UPEMLV)
- EDX: ED447, Ecole Doctorale of Ecole Polytechnique and ENSTA
- SISEO: ED489, Sciences et Ingénierie des Systèmes, de l'Environnement et des Organisations (Univ. Chambéry)
- SMAER: ED391, Sciences Mécanique, Acoustique, Electronique et Robotique (UPMC)
- SSMMH, ED456, Sciences du Sport, Motricité et du Mouvement Humain (U-PSud)
- STITS: ED422, Sciences et Technologies de l'Information, des Télécommunications et des Systèmes, (U-PSud, Supelec)

Universities, Engineering Schools, Research Organisms, Funding Agencies

- ADEME: Agence de l'Environnement et de la Maîtrise de l'Energie
- Alliance: National Thematic Federations of research organisms and universities
  - ALLISTENE: the Alliance for Computer Science and IST
  - ANCRE: The Alliance for energy
- ANDRA: Agence Nationale pour la gestion des déchets radioactifs
- ANR: Agence Nationale de la Recherche - National Research Agency
  - ANR supports several research programs either of general type such as « basic science » or JCJC specific for young researchers, and more oriented ones like CONTINT, TecSan, MDCO, CSOSG…
- BRGM: Bureau de Recherches Géologiques et Minières
- CEA: Commissariat à l'Energie Atomique et aux Energies Alternatives
- CNAM: Conservatoire National des Arts et Métiers
- CNRS: Centre National de la Recherche Scientifique, National Center for Scientific Research
- CNES: Centre National d'Etudes Spatiales, National center for Space Studies
- Competitiveness Cluster. Launched in 2005, these clusters aim at bringing together academis research and industrial needs on a regional basis. There are about 70 such clusters. The projects are funded by the Fonds Universel d'Investissement (FUI). LIMSI is tightly linked with two such clusters:
  - Systematic: Competitiveness Cluster for IST located on the Plateau de Saclay
  - CapDigital: Competitiveness Cluster for IST located downtown Paris
- CSIS : College of Engineering Sciences, convention between ECP, Supelec, ENS-Cachan and U-Psud
- DGA: Délégation Générale pour l'Armement
- DIGITEO: The RTRA dedicated to IST on Plateau de Saclay
- ECM: Ecole Centrale de Marseille
- ECN: Ecole Centrale de Nantes
- ECP: Ecole Centrale de Paris
- ENPC: Ecole National des Ponts et Chaussées
- ENS: Ecole Normale Supérieure
- ENSAM: Ecole Nationale Supérieure des Arts et Métiers
- ENSCI les Ateliers: Ecole Nationale Supérieure de Création Industrielle
- ENSIIE: Ecole Nationale Supérieure d'Informatique pour l'Industrie et l'Entreprise
- ENSMA: Ecole Nationale Supérieure de Mécanique et d'Aérotechnique, Poitiers
- ENSTA: Ecole Nationale des Techniques Avancées (Engineering School for Advanced Technologies
- EdF: French Energy Commission
- EU: European Commission
- FCS: Foundation for Scientific Cooperation, managed under private regulation
  - The FCS on the plateau de Saclay (FCSPS) runs the RTRA DIGITEO
- FP7: 7th Framework programme of the EU
- FUI: Fonds Universel d'Investissement: funds the projects of the competitiveness clusters
- GdR: Groupement de Recherche (National thematic federation of labs or research teams labelled by CNRS)
- IFSTTAR, Inst. Français des Sciences et Technologies des Transports, de l'Aménagement et des Réseaux
- INP: Inst. National Polytechnique, local regroupment of engineering schools such as in Grenoble (INPG), Toulouse (INPT), Lorraine (INPL)
- INRA: National Institute for Agronomy Research
- INRIA: National Institute for Computer Science
- IRD : Inst. de Recherche pour le Développement
- IRSN : Inst. de Radioprotection et de Sûreté Nucléaire
- ONERA: Office National d'Etudes et de Recherches Aérospatiales
- OSEO: Funding agency for the small and medium private companies

- Polytech: Engineering school of Universities U-PSud and UPMC
- PRES: Pôle de Recherche de l'Enseignement Supérieur (Local Federation of Universities or Schools)
  - PRES UniverSud gets together Supelec, U-Psud, ENS Cachan and ECP
- RTRA: Réseau Thématique de Recherche Avancée
- Supelec: Ecole Supérieure d'Electricité, Gif-sur-Yvette
- UCBN: University of Caen Basse Normandie
- UEVE: University of Evry-Val d'Essonne
- UJF: University Joseph Fourier (Grenoble)
- UPDD: University Paris Denis Diderot (Paris 7)
- UPEMLV: University Paris-Est Marne la Vallée
- UPMC: University Pierre & Marie Curie (Paris 6)
- UPS: University Paul Sabatier Toulouse
- U-Psud: University Paris-Sud, Orsay
- UPVD: University of Perpignan Via Dominici
- UVSQ: University of Versailles Saint-Quentin
- X: Ecole Polytechnique

The "Investments for the Future" initiative

In 2009, the government launched the "Investments for the future initiative" (35 billion €, 19 for research and higher education). This initiative aims at boosting the competitiveness of the french economy through an improved synergy between academic research and industrial needs in approximately 15 regional clusters of international visibility. Several modalities have been proposed on the basis of call for proposals which have been evaluated by international committees.

- EquipEX : Excellence equipment. Endowing research groups with major scientific equipments
- LabEx : Excellence laboratories ; getting together teams of high quality around major scientific challenges. LIMSI is part of two Labex, LASIPS, and DIGIWORLDS
- IdEx : Institute of Excellence : local regroupment of universities, engineering schools, research organisms which want to join their forcesr to improve their international visibility.
- IEED : Institute of Excellence for Decarbonated Energies
- IRT : Institute for Technological Research

National or Local governing or evaluation bodies

- CCSU: Commission Consultative de Spécialistes de l'Université
- CoNRS: National Council of Scientific Research
- AERES: National Evaluation Agency for Research and Higher Education
- CNU: National Council of Universities

Positions

- DR: CNRS Directeur de Recherche: SeniorResearcher
- CR: CNRS Chargé de Recherche: Junior Researcher
- Prof: University Professor
- Ass. Prof: University Assistant Professor
- HDR: Holder of ability to supervise PhD's
- ITA: CNRS employee: Engineer, Technician, or Administrative Staff
- CDD: Temporary position with specified ending date

    There are 4 types of CDD: PhD CDD, Post-Doc CDD, Research CDD, support CDD

- CDI: Indefinite Temporary Position
- CIFRE: PhD position (in general CDD) in a private company in relation with a laboratory

Laboratories with which LIMSI collaborates

- ALPAGE: Analyse Linguistique Profonde A Grande Echelle, UMR INRIA-Univ. Paris7
- APC: AstroParticule et Cosmologie; UMR 7164 CNRS-CEA-Observatoire de Paris-Collège de France-Univ. Paris 7
- CEA/DAM: Division of Military Applications of CEA
- CEA/DSM/IRFU: Institut de Recherche sur les lois Fondamentales de l'Univers
- CEA/DRT/LIST: Laboratoire d'Intégration des Systèmes et des Technologies
- CERFACS: Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique, Toulouse
- CERMICS: Centre d'Enseignement et de Recherche en Mathématiques et Calcul Scientifique, ENPC-INRIA-UPEMLV
- CETHIL: Centre de Thermique de Lyon; UMR 5008 CNRS-INSA Lyon-Univ. Claude Bernard
- CReA: Centre de Recherche de l'Armée de l'Air
- DynFluid: Laboratoire de Dynamique des Fluides, EA92 Arts&Métiers ParisTech-CNAM
- EM2C: Energétique moléculaire et macroscopique, Combustion ; UPR CNRS 288, ECP
- ER-TIM: Equipe de Recherche « Textes, Informatique et Multilinguisme », EA 2520, INALCO

- ETIS: Equipes Traitement de l'Information et Système, UMR8051 CNRS-ENSEA-Univ. Cergy-Pontoise
- FAST: Fluides, Automatique, Systèmes Thermiques; UMR 7608 CNRS-UPMC-U-PSud
- G2ELab: Grenoble Génie Electrique, UMR 5269 CNRS UJF
- GEM: Institut de Recherche en Génie Civil et Mécanique, UMR6183 CNRS-ECN-Univ. Nantes
- Gipsa-Lab: Grenoble Images Parole Signal Automatique, UMR 5216 CNRS-Univ. de Grenoble
- GREYC: Groupe de Recherche en Informatique, Image, Automatique et Instrumentation de Caen, UMR 6072, CNRS-UCBN-ENSICAEN
- ICJ: Institut Camille Jordan, UMR5208 CNRS-Univ. Claude Bernard
- IEF: Institut Electronique Fondamentale, UMR 8622 CNRS - U-Psud
- IJLRA: Institut Jean Le Rond d'Alembert; UMR 7190 CNRS - UPMC
- ILSP: Institute for Language and Speech Processing, Athena Research Center (Greece)
- IMFT: Institut Mécanique des Fluides de Toulouse; UMR 5502 CNRS-INPT-UPS
- IPNO: Institut Physique Nucléaire d'Orsay, UMR CNRS – U-PSud
- IRCAM: Institut de Recherche et Coordination Acoustique/Musique
- IRISA: Institut Recherche en Informatique et Systèmes Aléatoires, UMR 6074 CNRS-Univ. Rennes-INSA-INRIA
- IRIT: Institut de Recherche en Informatique de Toulouse, UMR 5505 CNRS-UPS-INPT
- IRPHE: Institut de Recherche sur les Phénomènes Hors Equilibre, UMR 7342 CNRS-Univ. Aix-Marseille, ECMarseille
- ISTerre: Institut des Sciences de la Terre UMR 5275 CNRS-UJF-UdS-IRD-IFSTTAR
- LadHyX: Laboratoire d'Hydrodynamique de l'Ecole Polytechnique, UMR 7646 CNRS-X
- LAUM: Laboratoire d'Acoustique de l'Université du Maine, UMR6613 CNRS-Univ. du Maine
- LBT: Laboratoire de Biochimie Théorique, UPR CNRS 9080
- LEMTA: Laboratoire d'Energétique et de Mécanique Théorique et Appliquée; UMR 7563 CNRS-Univ. Lorraine
- LGEP: Laboratoire de Génie Electrique de Paris ; UMR 8507 CNRS-Supelec-U-PSud-UPMC
- LIF: Laboratoire d'Informatique Fondamentale de Marseille UMR 7279 CNRS-Univ. de la Méditerranée-Univ. de Provence
- LIFO: Laboratoire d'Informatique Fondamentale d'Orléans, EA 4022 Univ.Orléans-ENSI de Bourges
- LIG: Laboratoire d'Informatique de Grenoble ; UMR 5217 CNRS-UJF-INPG
- LIM: Laboratoire d'Informatique Médicale, Univ. Rennes
- LINA: Laboratoire d'Informatique de Nantes Atlantique, UMR 6241 CNRS-Univ. Nantes
- LIP6: Laboratoire d'Informatique de Paris 6, UMR 7606 CNRS-UPMC
- LIPN: Laboratoire d'Informatique de Paris- Nord, UMR 7030 CNRS-Univ. Paris Nord
- LIUM: Laboratoire d'Informatique de l'Université du Maine, EA 4023
- LIX: Laboratoire d'Informatique de l'X; UMR 7161, CNRS Ecole Polytechnique
- LJAD: Laboratoire Jean-Antoine Dieudonné, UMR 7351 CNRS-Univ. Nice Sophia-Antipolis
- LML: Laboratoire de Mécanique de Lille, UMR 8107, CNRS-Univ. Lille-ECL
- LMO: Laboratoire de Mathématiques d'Orsay UMR 8628 CNRS-U-PSud
- LORIA: Laboratoire Lorrain de Recherche en Informatique et ses Applications, UMR 7503 CNRS-Univ. de Lorraine-INRIA
- LPED: Laboratoire Population Environnement Développement, UMR 151 IRD-Univ Aix-Marseille
- LPGP: Laboratoire de Physique des Gaz et des Plasmas, UMR 8578, CNRS-U-PSud, Supelec
- LPL: Laboratoire Parole et Langage, UMR 7309 CNRS-Univ. de Provence
- LPNCog: Laboratoire de Psychologie et Neuropsychologie Cognitives, FRE 3292 CNRS-Univ. Paris Descartes
- LPP: Laboratoire de Phonétique et de Phonologie, UMR 7018, CNRS-Univ. Sorbonne Nouvelle
- LRI: Laboratoire de Recherche en Informatique; UMR 8623 CNRS-U-PSud
- LSPM: Laboratoire des Sciences des Procédés et des Matériaux; UPR CNRS 3407, Univ. Paris Nord
- LTCI: Laboratoire Traitement et Communication de l'Information, UMR 5141 CNRS-Telecom ParisTech
- LUTH: Laboratoire Univers et Théories, Observatoire de Paris, UMR8102 CNRS-Univ. Paris Diderot
- L2S: Laboratoire des Signaux et Systèmes, UMR 8506, CNRS-SupElec-U-PSud
- MAP: Modèles et simulations pour l'Architecture et le Patrimoine UMR 3495 CNRS-MCC
- MIG: Mathématique, Informatique et Génome, Unité INRA
- M2P2: Laboratoire de Mécanique, Modélisation et Procédés Propres, UMR6181 CNRS-Univ. Aix Marseille
- MODYCO: Modèles, Dynamiques, Corpus, UMR 7114 CNRS-Univ. Paris Ouest
- MSME: Laboratoire de Modélisation et Simulation Multi-Echelles, UMR 8208 CNRS-Univ. Marne la Vallée
- PIMENT : Laboratoire de Physique et d'Ingéniérie Mathématique pour l'Energie et l'Environnement, Univ. La Réunion
- PMMH: Physique et Mécanique des Milieux Hétérogènes, UMR 7636, CNRS-ESPCI-UPMC-UPDD
- PPRIME: Pôle Poitevin de Recherche et Ingénierie en Mécanique et Energétique; UPR CNRS 3346, ENSMA, Univ de Poitiers
- PROMES: Laboratoire Procédés, Matériaux et Energie Solaire: UPR CNRS 8521, UPVD
- SATIE: Systèmes et Applications des Technologies de l'Information et de l'Energie ; UMR 8029 CNRS-ENS Cachan-CNAM Paris-Univ. Cergy-Pontoise

PATRICK LE QUERE AND ANNE VILNAT

Introduction

LIMSI is a laboratory of the CNRS associated with two universities, the University of Paris-Sud, on the grounds of which it is located, and University Pierre and Marie Curie, through its historical links with the mechanical engineering component within this university. Its principal characteristics are to host a wide spectrum of research, ranging from thermodynamics to cognitive psychology, which classifies it as an interdisciplinary laboratory. LIMSI's span of research bridges across engineering sciences and computer sciences. What gives unity to the laboratory is the common will to carry out research aiming at improving the well being of man in his/her surrounding world, both from material and immaterial aspects. Our research strives at endowing our society with better means of managing and using the exponentially increasing fluxes of information, more efficient and natural communication ways between humans and machines, more efficient industrial design processes, means of making the best use of available energy or natural resources, and more efficient and safer transportation means. Part of our research is also devoted to developing more efficient teaching capacities, to understanding how new interaction tools modify the human relationships and to providing substitutive capacities to disable people…

Achieving these objectives require developing the various skills needed by these applications. LIMSI thus contributes to the production of knowledge in the corresponding disciplinary fields, in particular in language science and technology, in human-machine interaction, in virtual and augmented reality, in mechanical engineering and energetics, in cognitive psychology and ergonomics. This amounts to developing new algorithms in signal processing, statistical methods, learning algorithms, in order to improve the predicting capabilities of the algorithms, either by taking into account new physical or social effects or through better models of existing phenomena, to design more robust algorithms by quantifying their sensitivity to various types of modeling errors, or by building knowledge resources as new language modeling, annotated corpora.

The quality of our research can be measured with the criteria of our double positioning, either along the classical criteria measuring the quality of our scientific production, or along the criteria quantifying the pertinence of our research with respect to our applied objectives. From this standpoint, as part of our research work aims to develop pertinent systems for large scale applications, LIMSI has established a long tradition of confronting its systems with those produced by other teams across the world. This is particularly true for spoken langage processing, where LIMSI has been involved in DARPA campaigns for more than 30 years on tasks of increasing complexity and has regularly be ranked amongst the very best over all these years. LIMSI has been very active in setting analogous campaigns in the domain of text language processing, either on Question and Answering tasks, or more recently on information retrieval applied to medical data. Likewise the Mechanics Energetics department has taken part or led several benchmark exercises, to quantify the accuracy and effectiveness of several algorithms for the resolution of the Navier-Stokes equations in given configurations. This common practice of submitting its algorithms to open challenges is another common feature of LIMSI's teams.

As an interdisciplinary laboratory, LIMSI depends on 4 CNRS's institutes, the Institute of Computer Sciences and their interactions to which it is principally linked since the end of 2011, the Engineering Sciences Institute, the institute of Human and Social Sciences, for its research in computational linguistics, and the Institute of Life Sciences, for its research on psychology ergonomics and some applications of computational linguistics to medical data.

As a result, it is evaluated, as a laboratory, by four sections of the National Committee of CNRS, the future section 7 dedicated to Information Science and technology, section 10 devoted to fluid mechanics, section 27 to cognitive sciences, and section 34 to languages sciences.

Research forces

Staff

As of 1 January 2012, LIMSI comprises of:

33 CNRS researchers (of which 2 are emeritus) : 13 Research Directors and 20 are Researchers (Chargés de Recherche) of which 7 hold an HDR. These CNRS researchers are attached to their CoNRS evaluation

section: 17 to section 7 "Computer science", 9 to section 10 "Fluid mechanics and energetics", 4 to section 34 "Language sciences", 2 to section 27 "Cognition, behavior, brain", 1 to section 9 "Solid mechanics, acoustics".

44 Professors and Associate Professors: 10 Professors, 34 Associate professors, of which 7 hold an HDR. These professors and associate professors are attached to their CNU evaluation section: 23 to section 27 "computer science", 16 to section 60 "mechanics", 3 to section 62 "energetics" and 2 to section 16 "cognitive sciences". 28 of them are employed by U-PSud, 9 by UPMC, and 7 by 6 other Universities or Engineering schools.

33 Support Staff: 31 ITA belong to CNRS, 1 to U-PSud and 1 to UPMC. 17 of these ITA are in the Direction group and carry out general administrative or infrastructure and computer support for the entire laboratory while the remaining 16 work directly as research support and are affected either directly in the groups or in common teams attached to a department working for several groups.

There are thus in total 77 CNRS researchers and professors that are presently affected to LIMSI for their research. 50 of them belong to the Human-Machine Communication department, and 27 to the Mechanics-Energetics department. 37 out of 77 hold an HDR. The variety of the evaluation sections, both on CNRS and University sides, is a clear indication of the pluridisciplinarity of LIMSI.

Approximately 60 students are working for their PhD thesis at LIMSI, approximately 45 in the Human-Machine Communication department, and 15 in the Mechanics-Energetics department. The number of Postdocs is approximately 35. It has considerably increased over the last 4 to 5 years, under the combined effect of the ANR projects, and of the Quaero program.

Financial resources

The total funding budget of LIMSI amounts to 13,3 M€ in 2011. Approximately 9 M€ come from the state (corresponding to the salaries of the permanent staff and to the state funding coming from CNRS, U-PSud and UPMC), and 4.3 M€ correspond to our resources coming from our research projects (ANR, FUI, UE). The table below shows the evolution of the functioning resources (own resources and state support) over the last 10 years and their breakdown as a function of the different funding agencies. This graph shows the considerable impact of the ANR projects as of 2006 and of the Quaero program as of 2008 on our total financial resources.

Evolution of financial resources (state grant and own resources)
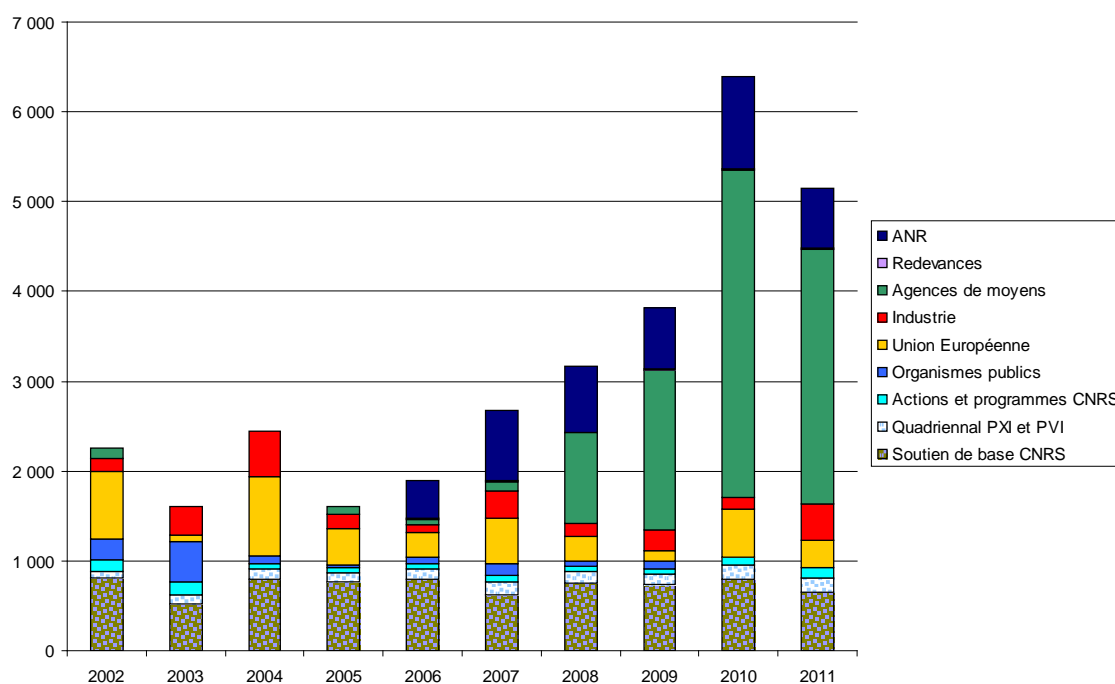
Scientific publications

The table below shows the evolution of our scientific production over last five years 2007-2011, classified according to the AERES nomenclature. It shows that the objective that was assigned of 1 peer reviewed article per permanent researcher or professor per year is about to be reached and that each researcher publishes yearly two items in a conference with proceedings and one without proceedings.

	2007	2008	2009	2010	2011
ACL	40	38	42	51	59
ACLN	3	3	6	7	12
ASCL	5	1	3	1	2
OS	15	11	20	23	35
DO	5	3	5	5	7
ACTI	105	106	93	156	123
ACTN	33	34	35	24	34
COM+AFF	26	46	49	71	75
Total	206	196	204	267	272

Over the same period, 60 PhD theses have been successfully defended and 10 researchers and associate professors have passed their HDR[1].

LIMSI and its regional environment

Synergy between research and teaching

LIMSI's research is intimately connected with the University Paris-Sud and the University Pierre and Marie Curie, as 28 and 9 professors and associate professors of these universities carry our their research at LIMSI. The 28 professors of University Paris-Sud are members of 4 internal teaching departments; the Department of Computer Sciences, the Department of Physics, the Technology Institute, and Polytech, the U-Psud internal engineering school. As for UPMC, the 9 professors are part of the Engineering Department. These professors and associate professors use their research skills to propose advanced graduate courses while participating in the general undergraduate programs. They give advanced courses in language science and technology, in signal processing, in man-machine interfaces, virtual reality, cognitive ergonomics, and advanced numerical and experimental methods in fluid mechanics and heat transfer.

At the graduate level, our research students depend on 3 major graduate schools, EDIPS, the computer science graduate school of U-PSud, MIPEGE, a U-Psud graduate school for multidisciplinary modelisation and SMAER, the mechanical engineering School of UPMC. It also happens that some students, due to research collaborations, are enrolled in other schools in the Paris Region.

LIMSI and the Plateau de Saclay

The Plateau de Saclay was intended in the 70's to become a unique location, gathering major actors of academic research and high technology companies with the aim of creating a dynamic for bringing together research and innovation in the area. This project, which has been sleeping for almost 30 years, is now back on the road again and LIMSI is taking full part in its dynamics, which will ultimately lead to the creation of the University of Paris-Saclay.

This dynamic was originated in 2007 through the labellisation of the RTRA Digiteo in computer science,

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[1] The HDR, « Habilitation à Diriger des Recherches » endows its holder with the ability to direct PhD theses. It is also necessary to apply for a full professor position.

and LIMSI was one of its six founding laboratories. Digiteo has played a major role in establishing the importance and role of computer science on the Plateau de Saclay and in federating all of its actors, includng those already present and those who will join the Plateau in the future. LIMSI has benefitted from important support from Digiteo, namely two chairs, one for Pr. H. Ney from the University of Aachen, who has obtained a support to spend half time at LIMSI over a three-year period, the other for T. Isenberg from the University of Groningen, in collaboration with the Aviz team of INRIA. Digiteo has also supported two large equipment projets: SIMCOD, with participation from CNRS, to install the large immersive facility EVE in the new building 512; a computing platform to support our activity in language science and technology, which needs larger computing resources and power to better train the statistical models for activities such as automatic speech recognition, multimedia transcription or automatic translation for instance. We have also benefitted from several research projects, which have helped develop internal collaborations within Digiteo, often through common supervision of PhD thesis, such that over the last 4 years, 12 PhD theses have been funded through Digiteo.

Digiteo has been instrumental in pushing the Equipex Digiscope, which aims at linking together all the facilities already present at CEA, ECP, LRI and LIMSI in a collaborative environment to create a world renowned center for advanced visualization and information extraction from complex massive data. It was also instrumental in pushing through the LabEx Digiworlds, which aims at focusing part of the research in computer science on 3 main key challenges, one of them "DataSense" (Making sense out of massive data) being directly connected to the Human-Machine Communication department.

The Mechanics-Energetics department is part of the LASIPS labex, which aims at forming a synergy between the classical engineering community, mechanics, both fluid and solids, electrical and bioengineering, of the various organisms or schools already present or which will be established in the future on the Plateau. This newly established Labex has launched its first call, and two of our proposals have been accepted, one with LGEP on MHD modelling, and the other with EM2C on thermal transport at the nanoscale.

Since the IdeX Plateau de Saclay has been accepted at the beginning of 2012, LIMSI actively participates in the ongoing discussions about the creation of two disciplinary departments, the Computer Science department and the Mechanics department. These departements will organize the teaching and research in their respective disciplines within the School of Engineering and Information Science and Technology.

Ongoing projets

LIMSI is waiting eagerly for the realization of two major infrastructure projects:

- The first one concerns the buiding of the extension that was decided in 2006 in the framework of the CPER 2007-2013 program. The purpose of this extension is to allow for the development of our research in language science and technology, in particular in the context of our collaboration with our German partners. This was supported by CNRS through the creation of an International Institute for Multilingual and Multimedia Information (IMMI). This extension will have an area of 2300m^2. It is financed by CNRS and by Conseil Général de l'Essonne. This extension will fill the gap between buildings 508 and 512 and will thus allow a reconsolidation of all LIMSI's staff, for a better scientific synergy.
- The second one concerns the installation of a new computer facility within building 508. Initially planned as part of the future extension, it was decided to build that facility in advance to allow for the installation of the new equipment supported by Digiteo, as this was not possible in the present computing room. The new computing room will be 100m^2, will have 150kW of electrical power available, and will provide secured watercooling of the equipment. It is planned to be completed at the beginning of 2013.

Last word

LIMSI is an interdisciplinary laboratory which holds specific research competences in its research domains. It has been an active member of Digiteo since its creation and has developed many collaborations with the laboratories or teams that are already, or will eventually be, on the Plateau de Saclay. As one of the major vectors of CNRS's presence of the Plateau, LIMSI enthusiastically and willingly wishes to put its research and teaching skills to the building of the future University of Paris-Saclay.

Mechanics-Energetics Department

Patrick Le Quéré

Introduction

Fluids Mechanics and Heat and Mass Transfer are key scientific disciplines at the heart of many crucial societal challenges in the domain of energy, transportation, and environment. Indeed, achieving more efficient, more reliable, more environment friendly means of converting or using energy, of transporting people and goods, requires a better identification of the corresponding technological bottlenecks and in turn a deeper knowledge of the involved physical mechanisms in all their intrinsic complexity and mutual interactions. It also requires a continuous progress in numerical modelling and simulation capabilities that are instrumental to mastering and optimizing the technological processes and that stand at the heart of a progressive substitution of empirical know-how by a deterministic approach in the conception and design processes. Along these lines, the research in the Mechanical Engineering department of LIMSI aims at a better understanding of fluid and transfer phenomena, isolated or in interaction, and at the development of efficient methodologies, numerical or experimental, to improve on the predictive capabilities of the models and their numerical simulation. Achieving better predictive capabilities is also instrumental for the development of methodologies aiming at optimizing or controlling the events or processes in which these phenomena are involved. Our research thus follows a dual strategy, proceeding either along a deductive process, each research topic progressing along its own logics, or along an inductive process, building upon concrete situations or configurations raised by our industrial or societal partners. We strive to keep a balance between these two approaches in order to reconcile both objectives of contributing to knowledge advancement while putting our skills at work for the benefit of society, the main specificity of engineering sciences.

Research axes

Research in the mechanics-energetics department addresses a large variety of situations in fluid mechanics and energetics. This variety stems from the range of scales which are addressed, from micrometers in nanoscale heat transfer to tens of meters in outer aerodynamics; from the range of speeds, corresponding to incompressible flows characterized by small Reynolds numbers up to supersonic flows; from the variety of the investigation methodologies, covering both numerical and experimental techniques; from the variety of numerical methods which are used or under development, finite volume, finite element, deterministic or stochastic spectral methods as well as reduced order methods; from the variety of objectives, from pure knowledge advancement to proof of the concept demonstrators. This diversity of methodologies and goals, which constitutes our common global scientific expertise, is organized in three research groups, Unsteady Aerodynamics, Convection and Rotation and Solid-Fluid Transfer which present their research individually in detail in this scientific report. These three groups share or develop in common a lot of methodologies, either numerical or experimental. To place our research in a more general perspective, it can be described along two main themes, "aerodynamics" and "transfer and energetics", which give global coherence to our scientific project.

Fluid mechanics: instabilities and turbulence

Fluid mechanics has profoundly evolved over the last decades through the increasing availability of techniques or tools, either numerical or experimental, allowing for a deeper understanding of its unsteady characteristics, and by the development of tools aiming at mastering this unsteadiness, either through manipulation or control, in order to achieve predefined objectives. The department had taken part in the early development of Large Eddy Simulation (LES) methods that are able to simulate the high Reynolds number highly unsteady flows typical of external flow aerodynamics with a threefold objective: educing and understanding the space time structure and dynamics of the detached flows; developing numerical tools capable of handling configurations of industrial needs; using these tools to develop manipulation and control strategies. In order to achieve these objectives one needs to improve simultaneously on the quality of the numerical approximation, better solutions for cheaper, on the capacity of the modelling of the sub grid scales to better ascertain the part of the numerical dissipation due to the subgrid modelling from that coming from the numerical approximation unavoidable at large Reynolds number. Our recent developments have

consisted in developing high order schemes allowing for shock capturing in compressible flows, and on the development of multiresolution adaptive approximations. Another crucial point for LES is the issue of the generation of inflow boundary conditions in open flows to limit the domain extent or the modelling of turbulent structure developments in the wall vicinity to alleviate the huge CPU-resources that would be needed to accurately resolve the large near wall velocity gradients. Concerning the inflow conditions, the aim is to reproduce the coherent structure development in a sub-domain or on boundaries of the computation domain with a dynamical behaviour representative of the physical mechanisms involved. This research was supported by the ANR project CALINS, which we led with the collaboration of PPRIME, LML and LEMTA. We also actively participated to the WALLturb European FP6 project led by LML for educing the turbulent structures in the wall vicinity, developing wall modelling based on model reduction techniques such as Proper Orthogonal Decomposition, and coupling with success these models to a zonal LES.

As LES models rely on an explicit modelling of the unresolved scales, their predictive capabilities need to be assessed through detailed comparisons with corresponding turbulent realizations, performed either with direct numerical simulations or obtained from real experimental flows, either type of comparisons raising its specific difficulties. In-house experimental comparisons are made possible by the availability of an experimental set-up consisting of a boundary flow interacting with a notch at moderate Reynolds numbers, a generic configuration appropriate for many applications. One of the basic objectives is to check the fundamental assumption underlying LES that is the fact that the numerical scheme produces an accurate space time evolution of all spatial scales down to the filter scale. This requires quantification of this space time dynamics which is done using combination of pointwise and field techniques such as PIV, for which we have developed our own post-processing algorithms. Part of this work has been led with the support of the ANR project HISPEED PIV, coordinated by FAST, and also with the support of another project DIB, aiming at correlating the wall pressure fluctuations with the far field acoustic energy. Performing these comparisons raise the issue of quantifying the difference between two intrinsically stochastic turbulent realizations. As pointwise comparisons or comparisons of first and second order moments are obviously meaningless or insufficient, one is led to resort to criteria combining deterministic and stochastic aspects. Model reduction techniques such as Proper Orthogonal Decomposition constitute one way to achieve this purpose, as we saw before. We have more recently turned towards dynamic mode decomposition, known as Koopman modes, which allows relating the time and space characteristics of the modes and therefore seems to offer some advantages in the context of model reduction for designing feedback control laws (PhD of J. Basley). The quantification of the space-time dynamics is also required for a better knowledge of the glottal flow that is a pulsating high aspect ratio jet involved in voice production. A Stereoscopic Particle Image Velocimetry setup was then used to measure the 3D velocity fields of the airflow created by a self-oscillating vocal fold replica. This enabled to perform, for the first time, a three-dimensional reconstruction of the glottal jet throughout a glottal cycle. Moreover, a similarity analysis has been proposed for the time-averaged fields of a glottal-like jet in a region close to the jet exit, which takes into account its three-dimensional nature. We then highlighted similarity properties useful to predict the axis-switching phenomenon, characteristics of jets with large transverse aspect ratio.

Another possibility is to compare Large Eddy Simulations with Direct Numerical Simulation (DNS), which allows for exact similarity of geometry or boundary conditions, which is hardly achievable with experimental set-ups. The main limitation is that DNS are limited to values of Reynolds numbers corresponding to mildly turbulent flows and simple geometries compared to industrial needs. DNS requires the use of high order numerical techniques which has long promoted the use of spectral methods, in which the department has been very active. For solutions that exhibit steep local gradients, which can move in the computational domain, an alternative is the use of local adaptive mesh refinement that have been applied to the computation of reference solutions on classical problems of 2D shock tubes, for instance. These techniques have been so far implemented in the context of explicit time integration, and their implementation for implicit time integration is a major challenge that has been undertaken recently. In addition, to account for complex geometries with Cartesian grids and to deal with the computationally challenging problem of Fluid-Structure Interactions, a new conservative coupling algorithm has been developed in the PhD of L. Monasse, through an Embedded Boundary Method that is very competitive compared to more classical methods for flow problems with moving deformable bodies.

Direct Numerical Simulations also allow for detailed studies of transition to turbulence or weakly turbulent flows when dealing with flows limited by solid walls. DNS has recently been used by B. Piton for his PhD to study the dynamics of helical vortices such as those which develop at the tips of wings or helicopter blades, showing different types of pairing or merging behaviour. For turbulence studies, the availability of increasing computing resources and their more efficient use offered by parallelism have quite recently made possible simulations of turbulent flow or large spatial extension. These simulations have evidenced the

coexistence of laminar zones and turbulence puffs, in either plane Couette or pipe flows, which constitute major breakthroughs in understanding transition to turbulence in these subcritical configurations. Similarly DNS of plane Poiseuille flows with heat transfer have been performed in the framework of the PEGASE ANR project in order to understand and quantify the non-Boussinesq effects on the transfer properties of strongly asymmetrically heated boundary layers.

This know-how in numerical simulation at large Reynolds number combined with our expertise in the analysis of the unsteady vortex dynamics opens the way to the manipulation of flows with techniques like flow injection or suction in conjunction with passive or active control strategies. Initially developed in the context of the suppression of vortex shedding for the flow around a cylinder, these techniques have been extended to the generic problem of drag reduction in a turbulent channel flow with neural networks. Recent emphasis has been put on the development of feedback control techniques in the context of the ANR CORMORED project launched by the GdR Control of Detached Flows and led by LEA/PPRime in Poitiers. This possibility is investigated experimentally by developing an active plasma control of the aforementioned boundary-layer/cavity configuration in the PhD thesis of C. Douay. These control algorithms raise the issue of the robustness to the controlled flow with respect to small unavoidable perturbations in real life. From a more general standpoint, it is important to check that simulations of physical models do show some degree of robustness, here defined as the sensitivity of the numerical simulation to all uncertainty parameters entering in a complex physical model, whatever their origin, (geometry, physical parameters, boundary conditions). This has given rise to a new paradigm known as uncertainty quantification whose aim is to quantify the statistical characteristics of the solution as a function of the characteristics of the input random variables. The poor convergence of Monte Carlo like techniques has promoted the development of intrusive techniques knows as chaos polynomial expansions, a spectral like expansion of the solution along the direction of the random variables, which raises the difficult issue of the choice of basis functions. The PhD thesis of J. Tryoen, in collaboration with CERMICS, was dedicated to this problem for the particular case of hyperbolic systems where shock waves develop. This research is carried out in the framework of the ANR JC project ASRMEI and is also supported by a collaboration with CEA/DEN in Saclay. It also constitutes a new theme within the GNR Momas, whose main purpose is to develop tools to predict the large-scale underground migration of radioactive waste.

The department is also well identified for its expertise in the domain of convection and rotating flows, two classes of flows that share a profound analogy. Our expertise is based on a good knowledge of the phenomenology of these flows, of their scaling laws and of their transfer properties, allied to a know-how in their numerical simulation both in characterizing their stability criteria but also on their reliable simulations in chaotic and turbulent regimes. Instability studies have focused lately on understanding the relationship between 2D and 3D modes in a differentially heated cavity and also on the instability of a fluid rotating in a container with a free surface, which was the subject of the thesis of L. Kahouadji. This has required developing a method that solves simultaneously the governing equations in a domain that depends on the solution together with the linearized instability equations of the base flow. Much effort is currently devoted to the study of the non linear dynamics of the thermal convection flows in a differentially heated slot of infinite vertical extension, which exhibits soliton like structures for sufficiently large values of the Rayleigh number or in characterizing, which is the subject of the PhD of Z. Gao, and understanding the changes of large scale flow structure in cavities heated from the bottom. Let us also mention the recent start of the thesis of L. Oteski, the aim of which is to characterize the nonlinear dynamics and the mixing properties of the periodic flow in a differentially heated cavity after the onset of unsteadiness. Prediction of large scale unsteady patterns resulting from nonlinear effects in the context of the Faraday instability was also investigated by N. Périnet for his PhD defended in 2010, owing to the development of a very efficient numerical code based on front tracking techniques done in collaboration with Hongik University (Korea).

Important efforts have been made over the last few years to develop efficient numerical tools for the simulation of the MHD governing equations i.e. coupled Navier-Stokes and Maxwell equations, in the aim of understanding the conditions under which a magnetic field can be created from the kinetic energy of a conducting fluid, the assumption for the existence of the Earth magnetic field. More precisely our efforts have been directed towards developing a numerical model allowing studying the effect of the nature of the material in the VKS experiments aimed at reproducing the dynamo effect in a laboratory experiment. Numerical modelling and simulations are particularly important for this problem, which cannot be reproduced in the laboratory from a similarity standpoint. This model is developed in collaboration with University of Texas with two PhD's (A. Ribeiro, PhD defended in 2010 and F. Luddens, on going PhD). This model, which was specifically developed to take into account conditions at infinity and discontinuities in the electrical conductivity between solids and fluids, has allowed us to put in evidence the strong influence of the nature of the rotating propellers on the localisation of the magnetic field in the VKS experiment. In this context,

recent investigations have shown that the Lagrangian drift flow of a wavelike zero-averaged Eulerian flow can also play a role in controlling the magnetic generation.

Heat and Mass transfer, energetics

Heat and Mass transfer and energetics constitute the second main objectives of our research. Understanding the basic transfer phenomena and putting this knowledge at work in energetic systems is our motivation. We therefore study elementary basic transfer mechanisms up to energetics systems, which require a variety of tools and methodologies, mainly experimental but also numerical and theoretical. These studies are carried out within the Fluid-Solid Transfer group and also by the Convection and Rotation group as fluid mechanics and its specific methodologies play an important role in the Transfer configurations we are looking at.

Convection generally dominates the transfer mechanisms we are looking at. This is in particular the case of the studies that are carried out in the context of thermal efficiency of housing. Improving the thermal efficiency of building requires advanced modeling capabilities, capable of simulating the thermal performance of dwellings in interaction with their surroundings. We participate to a joint effort ADNBATI supported by the CNRS Energy research program to determine efficient ways of modelling the ventilation of houses, which raises the question of modelling and implementing velocity and pressure boundary conditions in incompressible flows at the boundaries of multiply connected domains. Fluid mechanics is also important because its nonlinear character can give rise to multiple solutions that in turn can result in different transfer properties. Thermal transport in housing also requires taking into account all modes of heat transfer, turbulent convection, radiation and conduction, which need the development of efficient coupling methodologies owing to the large CPU resources needed to carry out the corresponding simulations. This was supported by the CNRS Energy research program under project COCORACOPHA and has allowed investigating influence of the temperature boundary conditions due to the coupling of convection and radiation at high Rayleigh number therefore elucidating a long unresolved discrepancy between experimental measurements and results from numerical simulations in 3D cavities heated from the side.

One mass transfer situation in which convection plays an important role is that of evaporative cooling of a binary mixture, a prototype configuration of many natural or industrial applications. The rate of evaporation of the more volatile component depends on the convection pattern resulting from Rayleigh-Bénard type instability of a multi-component fluid. This study was carried out by B. Trouette for his PhD in collaboration with FAST and MSME, on the basis of combined linear stability, nonlinear simulations and experiments.

Another area of expertise where fluid mechanics plays an important role is the modelling and simulation of multiphase flows, which was an area of intense research at the international level over the last twenty years, given the large variety of numerical techniques that have been proposed for this purpose. In the department, aforementioned numerical techniques initially developed for two-phase isothermal flows have been extended to take into account temperature effects resulting in variation of mean thermodynamic pressures in the context of low-Mach number approximations. This algorithm has been used to simulate the dynamics of bubbles in a closed container initially at different mean pressures and is used by G. Prigent for his PhD to simulate bubble dynamics resulting from temperature effects for microfluidic applications. The objective is to extend this work to account for mass transfer due to phase change between the liquid and vapour phase, given the importance of phase change heat transfer to achieve heat transfer coefficients. One particular configuration is the calefaction phenomenon, under which a bubble of liquid levitates above the air cushion produced by its own vapour as it comes in contact with a flat surface at very high temperature. Calefaction is one particular realization of the ebullition crisis, which occurs when a fluid subjected to a given heat flux turns completely into a vapour sheet, thereby reducing the heat transfer coefficient and resulting in a temperature rise that can lead to material melting. A study is presently carried out with ESPCI to characterize the time dynamics of the complex spatial patterns that develop and it is hoped that this will open up the way to possible control of the ebullition crisis, a subject that can have enormous potential applications.

All the above studies rely on a fluid description as a continuum media. At micro-scales or at low temperatures, this description is no longer valid and one has to resort to solid physics quantum mechanics where heat is conveyed through wave-like packets known as phonons. This is the case for the Kapitza effect, in which the impedance misfit between a solid and a fluid at low temperatures gives rise to jump in temperature modelled as a thermal interface resistance, which is crucial in designing experimental set-ups such as accelerating cavities in particle physics. Much progress has been done in understanding the influence of the surface roughness by a rescaling procedure allowing explaining the large discrepancies of the results

reported in the literature so far. This is done through a continuous collaboration with IPNO. Thermal transport at microscale is also one very example where one needs to take into account the strong interaction between the nanowire and its substrate due to the change of the mechanisms of heat transfer at the junction. Quantification of this thermal resistance at the junction as a function of the diameter of the nanowire is part of the PhD subject of A. Ramière carried out in collaboration with EM2C in the framework of the GdR micro and nano thermal transport.

Part of our research aims at conceiving and optimizing cooling systems based on thermo-acoustics. Such systems, made of a compressor and a pulse tube, are complex to design and optimize as they are made of components that are themselves complex. The identification of the nominal functioning conditions must be carried out taking into account all irreversible losses and coupling conditions with the environment. The conditions of triggering the thermo-acoustic waves in the compressor, their non-linear saturation, the corresponding streaming effects with its consequences of heat losses, the heat transfer in oscillating flows are examples of phenomena which necessitate local refined studies whose results need to be put together to obtain a model of the global system. A number of studies have been carried out or are currently under development. The subject of the PhD thesis of Ph. Debesse, defended in 2008, was the experimental investigation, with the help of the PIV and LDV systems developed in the AERO group, of the flow structure resulting from the streaming effects. These results have recently been revisited in the light of the numerical simulations carried out with a full non-linear compressible algorithm which show that for large nonlinear effects the streaming motion becomes itself unsteady and gives rise to counterintuitive flow structure and corresponding heat transfer. An alternative numerical model was developed to alleviate the CFL limitations of a compressible algorithm to be able to simulate the phenomena over heat diffusion time scales. This algorithm couples a low Mach number approximation in the stack to pure linear acoustic in both resonator ends, one end being modelled as a loss through an impedance condition. This algorithm, developed in collaboration with University of Calgary, is presently used by L. Ma in his PhD work to study both triggering of the acoustic motion and the effects of the impedance on the nonlinear saturation. Experimental studies are carried out simultaneously by R. Paridaens for his PhD in order to determine experimentally the second order terms characterizing the streaming, a difficult task owing to the small amplitude of these steady deviations in the large amplitude fluctuating fields. Initiated on a Swift-Backhaus loop, a complementary Q-drive resonator was installed to calibrate the LDV measurements of velocity. In addition energy analysis of a complete loop has been initiated to better understand the sources of irreversibility. In parallel a global 1D model of thermo-acoustics systems is developed in collaboration with Hekyom, whose objective is to develop an expertise in the conception and optimization of thermo-acoustics systems. The objectives of this collaboration are to feed the global model with the results from detailed laboratory studies of the various components that make the system. The corresponding experimental validations of these concepts are carried out at IPNO, feedback from these experiments being at the origin of new local studies.

Claiming for an expertise in energetics would not be complete without skills in the thermodynamic analysis of systems. This expertise is based on an in-depth analysis of the basic thermodynamic principles, based on identification of the irreversibility losses and of the available exergy, allowing for efficiency comparisons of machines or systems of production of energy. It has been applied to various systems, either to quantify the exergy available in different solar systems or to thermo-acoustics systems.

Support teams

Cellule Informatique Graphique et Ingénierie Thermo-Aéraulique (CIGITA)

J. Chergui, A.T. Dang, Y. Fraigneau

Our research in fluid mechanics and heat transfer relies heavily on numerical simulations which are performed with our own numerical codes. Their efficient use and continuous improvement are thus at the heart of our ability to produce results at the best level. Their continuous improvement relies on our research work, and one of the objectives of the CIGITA support team is to capitalize the research efforts into numerical codes and to provide the researchers with very efficient codes, implementing known algorithms and schemes, and making efficient use of the available computing resources.

The CIGITA support team has the responsibility of providing the researchers with efficient tools, both hardware and software. On the hardware side, this includes both the administration oand maintenance of all the individual computer equipments, and of the three clusters and a data storage server that were recently acquired to allow for the development of parallelization of codes and algorithms.

On the software side, CIGITA has been involved in the development of numerical codes over the

years, with a strong emphasis over the last 3 years on parallelization.

- CHORUS (Y. Fraigneau, based on work of V. Daru & C. Tenaud on high order schemes). CHORUS performs 3D unsteady compressible flow simulations using either DNS or LES modeling. It implements OSMPX (X=2 to 11) a high order scheme with possibility of shock capturing. Coarse grain domain decomposition is possible through MPI. One licence was sold to CEA DAM in 2010
- OLORIN (Y. Fraigneau, based on initial developments of P. Le Quéré). OLORIN solves the 3D unsteady incompressible flow either in the Boussinesq regime or under the low Mach flow approximation through a prediction-projection time stepping scheme. Subgrid scale models are used in the case of turbulent flows. It allows forcoupled heat transfers (buoyancy driven effects, solid thermal conductvity) and also allows for immersed bodies.
- BLUE based on common developments by J. Chergui and D. Juric. BLUE performs the time integration of twophase 3D incompressible flow equations. It relies on the newest versions of the front tracking method with the possibility of breakup and coalescence modeling, and an accurate surface tension forces modeling. Parallelization is achieved by the use parallel algebraic solvers (MPI, GMRES and Multigrid Methods.
- SUNFLUIDH (Simulation of Unsteady Flows Under Incompressibility and Dilatability Hypothesis, Y. Fraigneau). SUNFLUIDH is the successor of OLORIN for parallel calculations. Different levels of parallelization are avalaible: domain decomposition (MPI). Hybrid parallelization is in progress Multithreading is based on OpenMP. Developments of GPU scientific libraries to solve Poisson and Helmholtz-like equations implied in the code (cf. DIGITEO CALIPHA project, LRI/LIMSI collaboration)

Experimental support team

V. Bourdin, D. Caqueret, V. Gautier, Y. Maire

The experimental support team provides a support in the conception of experimental set-ups for the experimental research activity carried out in the Mechanics-Energetics department, but also for the Man-machine communication department as some research of this department either in acoustics or in virtual reality increasingly relies on experimental investigations. The team has been considerably reinforced with the recent arrival of D.Caqueret, recruited on a CNRS assistant engineer position. The arrival of D. Caqueret has allowed V. Boudin to start a new collaboration with LGEP, supported through an internal LIMSI Incentive Support, on the effect of conjugate thermal effects on the efficiency of solar panels.

The team works importantly for the fluid mechanics activity, with a strong emphasis lately on the implementation of real time feedback control loop based on plasma actuators. It also works for the research in thermoacoustics with recent developments for LDV measurements of streaming effects.

Staff

Permanent Staff

Firstname	Lastname	Type of position	Employer	Arrival date	Departure date
Vincent	Bourdin	Res. Eng.	CNRS		
Dorine	Caqueret	Ass. Eng.	CNRS	Hired as of 01/01/2011	
Jalel	Chergui	Res. Eng.	CNRS		
Tuan	Dang Anh	Res. Eng.	CNRS		
Yann	Fraigneau	Res. Eng.	CNRS		
Vincent	Gautier	Technician	UPMC		
Yves	Maire	Technician	U-PSud		

PHILIPPE TARROUX AND ANNE VILNAT

Introduction

Research in Human-Machine Communication has become more and more important over recent decades. Two main aspects may be highlighted: how to interact with the machine, for which more and more (hardware or software) solutions are explored, and how to process human language, which is the most natural means to convey information. These two axes constitute the two research fields of Human-Machine Communication Department. Concerning interaction, the research focuses on the hardware aspect, with the development of new devices like large tactile surfaces with which humans may interact with a machine, or on tools for immersive interactions. The machine may be represented as a conversational agent with which the user interacts, or more complex embodied agents in immersive CAVE like envrironments. The repercussions on humans are also of importance and we must make all these interactions as natural or as useful as possible, depending on the applications. A particular field of interest is the application to the Arts.

Most information exchanged between humans is expressed by the means of language: whether in the form of on-line news texts (newpapers, for example) or recordings (broadcat news, for example). In these sources, the language is very normative. Another kind of language is found in blogs or forums: spontaneous conversations in written texts or speech. These last kinds of resources were less studied, but now become an important field of investigation, for applications such as opinion mining or detection of emotions. Another axis of variation concerns the variety of languages we want to deal with: we have to deal with different languages used by humans, to translate texts or speech or to find information in any possible language, or to recognize the language or the dialect spoken or used in a text.

There is no clear limit between all these studies, and even if the department is organized in six different groups, there are many common projects across them in which researchers from these different groups work together.

Research axes

Research in the Human-Machine Communication Department addresses the different aspects of communication. This diversity begins with the medium which is used to communicate: from voice to texts, sounds and music, gestures, visual contacts or a mix of these different media. The device used to interact with the machine, or with other humans via the machine is another source of diversity: from a classical interface (window, mouse and keyboard), to virtual reality tools or intelligent sensors in an I-room. Most of this research is concerned with interdisciplinary aspects: ergonomics (for usage studies concerning new interfaces), physical and perceptual aspects of acoustics (for research concerning audio), linguistics (for automatic language processing) or cognitive science (for perceptual studies in robotics). Some research fields are strongly related to societal aspects: designing virtual signers for the deaf and Sign Language community, developing special interactions to help people with autism to communicate, or audio metaphors to help the blind be more autonomous. Most of these research fields share a great need for computational power and storage, to deal with huge quantities of data, and efficient algorithms to deal with communication constraints such as real time operation.

The research is organized in six groups, and a transverse action with some common topics, studied from different points of view, which is why different groups may appear more than once. These collaborations between the groups are very fruitful in addressing a problem as a whole: taking into account both computer and human features for example. Human Language Technology mainly concerns the Information, Written and Signed Language group (ILES) for research on written and signed language, and Spoken Language Processing group (TLP) for spoken language. All the work done in these groups is strongly related to IMMI activities. The specificity of audio, speech or music concerns the Audio & Acoustics group (A&A), at the frontier between Human Language Technology and Interaction and between the two departments. Architectures and Models for Interaction group (AMI) deals with the variety of software or devices used to interact with humans. Cognition, Perception & Uses group (CPU) is mainly concerned by the study of human behaviour, for designing artificial perception for robots as well as creating natural virtual agents. The VENISE (for Virtual ENvironment for Immersive Simulation and Experiments) group is the principalresearch group in Virtual and Augmented Reality (V&AR). The transverse action VIDA (for Virtuality, Interaction, Design &

Art) is a collaborative theme dedicated to collaborations with creative professionals.

Human Language Technology

Research in Natural Language Processing (spoken, written or signed) has strongly evolved during the past decades with the availability of more and more freely available resources. The aim is to build a representation of what has been said on web-radios, written in texts or signed in videos so as to provide users with adequate information they may need. This information may be an answer to a question, a translation, a summary…

Research has been developed on the modelling and representation of languages. An important part of this work has consisted in corpus acquisition, to first study the language as it is used. These corpora are then annotated to go from signal, letters or body gestures to a defined representation. The specification of this representation is a fundamental activity. Corpus annotation following this specification constitutes an important research activity. It has a direct and concrete impact on the definition, training, and evaluation of language processing systems. To ensure the quality of the annotations, annotation and good practice guides must be defined.

In both groups (ILES and TLP), several annotated corpora have been produced, at different levels: transcriptions (of speech), at the syntactic level (PASSAGE ANR project), named entities and events (Quaero project), opinions (Doxa project), sign language (Dictasign and Dégels). It is to be noticed that the Quaero project has led to the manual annotation of two text corpora, each with 1.5 million words (one of press articles dating back to 1890, the other of transcriptions of radio and television broadcasts from the 2000's). This produced the largest French annotated corpus of named entities. It was also the first time two corpora of different kinds of text had been annotated in the same way in French. These annotated corpora now constitute "Gold Standards" to which systems may be compared. Their existence allows the organisation of evaluation campaigns. LIMSI takes an important part in the design of these campaigns, and participates as well to evaluate the systems we have built. These annotated corpora are also used to develop learning algorithms (to acquire language modelling, for example). The activities in corpus production are conducted in connection with the FLaReNet and META-NET European Networks.

Dealing with multilingualism aspects is an important part of our research. The systems we develop generally deal with several languages (at least French and English) to ensure their portability, at least with rather similar languages. Named Entities Annotation in news articles in French and English is the aim of the ANR project Edylex. On another scale, speech recognition deals with 18 languages. Multilingualism may also concern levels of language, comparing language for specialists with popular language (the one that lay people may understand). A lot of work has been done in the medical domain, comparing in this case what is said in scientific texts with texts on the Web.

Machine translation is probably the most popular field in natural language understanding. LIMSI has developed an important activity in this domain, following a statistical approach which relies on the availability of parallel corpora and machine learning algorithms. The development of Wapiti, an open source package for linear chain Conditional Random Field (CRFs) is a major achievement in this domain (with the CROTAL ANR project). Various evaluation campaigns like the WMT series has always ranked LIMSI amongst the top systems (the best one for translations from English to French in 2010 and 2011). A Google Award has also been given for this activity. This research is conducted in relation with T4ME Network of Excellence.

Information extraction constitutes a long-running topic, with the participation and good positions in international challenges, in open domains (TREC, CLEF) or in the medical domain (i2b2). Different types of target elements are searched for in texts: named entities (location, dates or persons to cite the most obvious ones), relations between entities, opinions, etc. We include more and more deep information (as opposed to surface representations) to select the most appropriate piece of information to extract. The research concerns both written and spoken languages. The ability to go further than a simple question and to manage a complete dialogue in an open domain is a more complex problem (in which information extraction is only part of the problem), on which we want to put new efforts: it is the aim of the Ritel project. To be able to reach this goal, robust analysis methods are developed. An application of these methods to understand texts to give Nao robots the ability to tell stories is developed in collaboration with the A&A group (in GV-Lex ANR project).

To deal with spoken language, an important topic is the speaker recognition, which is particularly useful in multimedia contexts, where several people may be speaking at the same time. This task is evaluated in the REPERE challenge. Another aspect concerns the perception and automatic processing of variations in speech. These variations may arise from geographic, social or stylistic diversity. The recognition of these

variations helps to improve the performance of speech processing. Speech recognition is one of the domains which LIMSI is well-known. The different systems have always been ranked amongst the top systems in international challenges, as it has been the case during the period of this report (DARPA, GALE, Evalita).

During this period, most of the research had taken advantage of the Quaero program, which enabled us to hire post-doctoral fellows, internships and PhD students. The transcriptions in the 18 studied languages have also necessitated hiring native speakers of these various languages.

Sign language processing is part of the ILES group. Sign Languages are visual-gestural languages. As all natural languages, they follow linguistic rules, but these languages do not at this time benefit from a precise linguistic description. The specificity of the LIMSI team is to be primarily concerned with the modelling and generation of sign language, relying on corpus acquisition and annotation, in relation to the research cited above. To generate signs, a virtual signer has been designed, in collaboration with WebSourd, and is used at Gare du Nord to sign messages for the deaf users.

Affective and social dimension detection is studied in the TLP group to detect emotion in spoken interactions, during human interactions (as in call centres; which is the subject of the Vox Factory project), or during interactions with robots (to maintain elderly people at home; the aim of the ANR ARMEN Project). The study of a social humanoid robot is the aim of the ROMEO project. This research is often done in collaboration with CPU.

The senior Digiteo chair given to Hermann Ney reinforces the relations between LIMSI and RWTH at Aachen, in the various fields of Human Language Technology.

Human Machine Interaction

The second axis on which research is developed in the Human-Machine department is dedicated to interaction processes. The first field is at the frontier of Language Technology, as it concerns the research on audio and sound in human interaction, in the A&A group. Three main aspects are concerned: audio analysis and synthesis, expressive prosody, and the study of sound and space. The first point includes voice and speech synthesis, singing voice and musical acoustics. In the GV-LEX project (in collaboration with TLP), the aim is to give a storytelling ability to the NAO humanoid robot, using text-to-speech synthesis with an improved expressiveness. A new approach is under study, concerning "chironomy", i.e. the analogy between hand gestures and prosodic movements. Organology is a long-running and well-known work done in this group, which LIMSI was invited to present in different events (concert in the city of Lille) and in a conference (CIRMMT at McGill University). The second theme is related to efforts in the TLP group concerning speech variations, but it also takes into consideration the relation with music. The last point explores virtual reality to develop virtual audio, and a new platform SMART-I^2 for the study of multimodal perception of audio, visual and audio-visual distance. It also concerns sound spatialisation in architecture. Spatialised audio rendering is used to develop a navigational aid for the visually impaired to improve the autonomy of its users: the aim of the NAVIG project.

The AMI group has moved from a focus on Graphical User Interface (GUI) to new software and hardware tools and new interaction environments. The interaction is designed for "ordinary people" who have to use more and more devices with limited knowledge of computers. Ambient environments (I-Room) are a first field where classical interaction (key, mouse and windows) cannot be used. The I-Room, a technological platform dedicated to experimentations in ambient environment, was created. New interaction models have to be designed to be adequate for such environments. In such environments, virtual and physical worlds have to be merged, which is done in a joint research action between AMI and the conversational agents developed in the CPU group. The relationship between the user and the global ambient environment is studied to check the psychological well-being of ordinary people in such environments.

New hardware devices are also designed, such as to make use of the haptic channel for the support of inter-personal communication. A first approach is the use of haptics to characterize abstract environments (in collaboration with the dept. of Mechanics-Energetics in the FLUCTUS project). Collaborative metaphors for usual collaborative actions and their roles for interpersonal awareness are the aim of the FRESCO project, in collaboration with CPU. Another kind of device is represented by tactile surfaces such as interactive tables. As the hardware aspects are uncertain, the development is focused on toolkits and information visualization. Tools remain to be invented to study group work around such devices, and it is the aim of the research in this topic.

Interaction includes dealing with image processing. This topic previously focused on medical imaging, with several applications. It has now moved to Spatial Augmented Reality, which raises many challenges,

such as Human-Scene interaction management, with algorithms implemented on GPU to optimize processing time. This work has been the object of collaboration with the ACCIS team of IEF. It has been used in different projects for art/science applications, in the context of VIDA (see below).

The CPU group is mainly concerned with cognitive, perceptual and emotional processes both in human and computer agents (i.e. robots or virtual agents). The aim is to provide answers to key questions in psychology about cognition, perception and use, and to design and evaluate advanced interfaces for human-machine interaction. Perceptual systems and models are built and tested on robots that allow a situated approach to cognition. A 3D-image capture system with a Kinect camera has been implemented on a Robulab-10 robot (thanks to a Digiteo project Roboteo-Handler). In a project with ETIS (the Auto-Eval project), the aim is to work on new navigation and planning models for this robot. The Interactions between Image, Language and Space have initiated several projects. The first one (in collaboration with A&A) concerned Navigation assisted by artificial vision and global navigation satellite system (NAVIG), to help blind people. The second one concerns the nature of spatial representations, how they are built and how they evolve with age (SPALIFE project).

Cognitive ergonomics focuses on how to model the cognitive activities of individuals when using highly-multimodal devices. The different cases envisioned are distant collaboration (CoCrea project) in architectural creativity, collaboration in virtual environments, and user-centered evaluation of virtual environments (both with VENISE).

The last topic of CPU concerns virtual agents and emotions and is subject of diverse collaborations with other teams at LIMSI. Facial expressions of emotions have been integrated in the platform MARC (Multimodal Affective and Reactive Character). Bodily interaction is less explored than facial expressions: it has been the object of the collaboration with the I-Room. Collaboration with a specialist in autism on the use of virtual characters has been developed.

The VENISE group is concerned with research in virtual and augmented reality, with application in the virtual reality environment EVE located at LIMSI, but also general enough to suit other kinds of environments.

The first topic concerns the study of interaction models in V&AR, which includes collaborative work (in relation with CPU). Mixed reality, with Augmented Virtuality for telepresence and telesupervision has been the object of SACARI for a semi-autonomous vehicle. Interactive and Illustrative Scientific Visualization has been explored by Tobias Isenberg during his Digiteo chair AVENIR. He also collaborates with the AERO team on fluid mechanics simulations.

The second topic concerns Data models and simulations, in which Interactive Molecular Simulation has been investigated, to provide simulations that are otherwise too difficult to observe. It was the object of the CoRSAIRe project, with a special attention paid to haptic interaction. ExaViz is a project focused on large-scale molecular simulations in virtual contexts. The simulation of physical phenomena that are not directly observable is another part of this topic, with the EVEILS project which aims at giving ideas of "what is" relativity and large scale gravitational phenomena. VR-CAD integration aims at creating a VR-CAD framework to enable intuitive and direct 3D edition on CAD objects within Virtual Environments.

VIDA

VIDA is a collaborative theme that gathers researchers from different groups in the Human-Machine Communication Department with creative professionals (artists, designers, architects). Most projects have been published both as scientific work and artistic events. Three topics are developed. The first one concerns virtual and augmented reality for the performing arts, architecture or visual arts. Digital media is part of the art piece, and the project involves the virtual aspects from the very beginning. Multimodal human-computer interaction for social life, music and dance or theatre performance constitutes the second theme of this action. The third one concerns virtual materiality for cognitive experiments in arts and science.

Staff

Permanent Staff

Firstname	Lastname	Type of position	Employer	Arrival date	Departure date
Jean-Baptiste	Berthelin	CR Researcher	CNRS		
Carole	Hoint	Adm. Staff	CNRS	14/03/2011	
Laurence	Rostaing	Adm. Staff	CNRS		
Gérard	Sabah	DR Researcher	CNRS		

JOSEPH MARIANI

Introduction

IMMI combines the research activities conducted in the field of Automatic Multilingual and Multimedia Document Processing at LIMSI-CNRS, the Technical University of Aachen (RWTH) and the Karlsruhe Institute of Technology (KIT). It consists of a network of Associated European Laboratories (LEA 547), which conducts the research investigations, and an International Joint Unit (UMI 3191), which provides coordination and support.

The objective of IMMI is to gather a major research effort to develop Language Technologies (LT) at the highest international level, in order to enable the automatic processing of multilingual data for the management of multimedia documents (text, voice, image, video), in view of the tremendous issues related to multilingualism in the European construction and more generally to globalization at the planet scale. Its action is particularly conducted in the context of the French-German Quaero program and of the programmes of the European Commission[2].

IMMI's mission is to support the coordination of research conducted in the partner laboratories. Its staff is therefore intentionally reduced to a few people, including the leaders of the research teams that cooperate. The core of IMMI is currently eight people, while the personnel participating in the research effort brings together about 170 people, on the three sites. This is probably nowadays the largest research task force on Language Technologies worldwide. Consistent with this role of supporting research on LT for multilingualism, IMMI is also involved in coordinating activities and promoting the field at local, national, European and international levels.

Presentation of activities

Quaero

The Quaero program was launched on May 1st, 2008, after a gestation period of three years. It is a large program, involving 31 partners nowadays, from France and Germany, with a budget of € 199 million, including € 99 million of public funding coming from OSEO Innovation, over a period of 5 years (2008 - 2013). The originality of the program (see Figure 1) is to conduct within a single program eight different application projects, each under the responsibility of an industrial company, that are fed by over thirty technologies developed within the Core Technology Cluster (CTC) project, under the responsibility of LIMSI through Jean-Luc Gauvain, Scientific Director of the program. Several technologies can serve one of the applications, and one technology can serve several applications. A specific project is also dedicated to the production of the corpus that are necessary to develop and test those technologies, under the responsibility of RWTH (Volker Steinbiss). The entire program is organized around the systematic use of the quantitative evaluation of the systems performances, in order to measure the state of the art of a technology, the progress accomplished and the suitability to the needs of the applications. IMMI is part of the Integrated Management Team, together with Technicolor and the DGA, where Martine Garnier-Rizet is responsible for the dissemination of scientific and technical information[3]. Research activities in Automatic Speech Recognition and in Machine Translation are respectively coordinated by LIMSI and RWTH. The funds provided to the partners gathered in IMMI amount to about € 20 million over the 5 years of the program.

The IMMI partners conduct research on Speech Processing (speech transcription, speaker diarization, spoken language identification), machine translation of text and speech, crosslingual information retrieval, and Natural Language Processing (terms acquisition and recognition, Named Entities extraction, acquisition of ontologies, semantic annotation and Question&Answer systems). The approach used by the partner laboratories in all these research areas is based on a comparative evaluation of system performances on common test data, and on the discussion of the methods used in the light of the respective results. Joint activities address the analysis and processing of errors in speech recognition, systems fusion for speaker verification and the use of several pivot languages in Machine Translation systems allowing for performance

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[2] http://www.immi-labs.org/
[3] http://www.quaero.org

improvements.

These results have been published in 529 communications and publications since the beginning of the program in 2008 up to September 2011. The number of joint publications reached 44 in the fourth yearly period 2010-2011. 66 technology modules have been delivered by the CTC project to the application projects, and 26 patent applications have been filed. IMMI maintains the list of publications and the Web site. It produced a catalogue of technologies and a set of videos demonstrating the Quaero results.
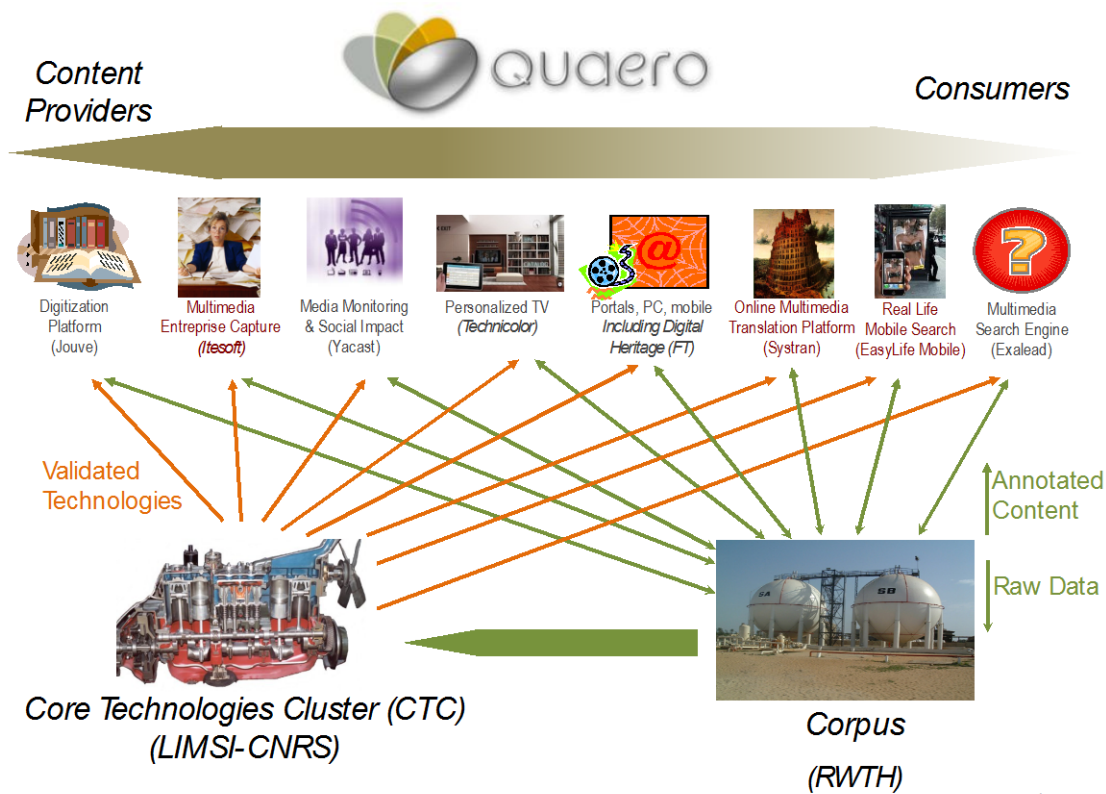
Fig. 1. Quaero Program Architecture
(The 3 new applications added during the course of the program are marked in red)

The results obtained in terms of technology improvement have allowed the development of innovative applications, in particular the Voxalead News Service, in collaboration among LIMSI, INRIA and the Exalead and Vocapia Research companies. This service can automatically index and search through audio data (radio, TV and video), while it was so far limited to textual data, for nine languages (English, French, Spanish, Mandarin, Arabic, Russian, Italian, German and Dutch). This major innovation in audio transcription opens new horizons. It has also been integrated into the HD player of France 24, and on applications related to media monitoring and social impact analysis by Yacast. Also, thanks to the automatic transcription of the President of the French Republic speeches, it is now possible to navigate through the videos on the Elysee site. Current developments address the increase of the number of languages covered, the addition of speaker recognition and the translation of transcripts. KIT has also developed the real-time Jibbigo speech translation system distributed on App Store for the iPhone and the iPad.

Local

Locally, IMMI is involved in the Digiteo RTRA[4]. Several projects were funded by Digiteo: processing and storage platform for multimedia / multilingual documents, learning from large oral datasets for spoken human-machine interaction (Amadeo). A three-year senior Digiteo Chaire d'Excellence was obtained by Hermann Ney from RWTH in 2009. A University Paris Sud 11 PhD thesis on handwriting recognition has been initiated under H. Ney's supervision in 2011, as a CIFRE contract with the A2IA company.

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[4] http://www.digiteo.fr/

In the dynamics associated with the French-German collaboration and with the Quaero program, the construction of a 2300 m2 building and the acquisition of computer resources are included in the *Contrat de Projets Etat-Régions 2007-2013*, totaling € 12.6 million funded by CNRS, the Conseil Général de l'Essonne and the RTRA Digiteo through the FCS foundation. The computer equipment acquired up to date amounts to € 1.6 million. Four architectural agencies were selected in January 2012 for the construction of the building, which will gather in a rational manner by 2014 the different places that presently host LIMSI activities.

National

Nationally, IMMI is involved in the promotion of Language Technologies with various ministries. J. Mariani has participated in the organization of the Multilingualism Summit organized in September 2008 at La Sorbonne by the Délégation Générale à la Langue Française et aux Langues de France (DGLF2) under the French Presidency of the European Union, in which Alex Waibel gave a plenary lecture on Language Technologies to support multilingualism. J. Mariani participated in the organization of the "Multilingualism in Overseas" Summit, also organized by the DGLF2 in Cayenne in December 2011, where he intervened and proposed to develop technologies for regional languages (metropolitan or overseas (Creole, Indian languages…)). J. Mariani also intervened within the Ministry of Economy, Finance and Industry to participate in a pilot study on the establishment of a multilingual portal for innovation in the context of the Euro-Mediterranean Euromed program, addressing the languages spoken in the Mediterranean region. He presented to the French representatives at the European Commission ICT Committee the challenges related to Language Technologies, which were included among the French priorities for the next Framework Program Horizon 2020 (2013 - 2020). There are also links with the Ministry of Defense (DGA), within Quaero and through our participation in the TIM (Traitement de l'Information Multimodale) annual DGA seminar, and with the Ministry of Foreign Affairs (MAE), which conducts a survey on the effect of Machine Translation on the status of the French language worldwide.

M. Garnier Rizet is President of the "Knowledge" Commission of the Cap Digital competitiveness cluster.

Europe

On the European plan, IMMI is a partner of FlaReNet (the Fostering Language Resources Network), established in September 2008, which aims at promoting the production and dissemination of Language Resources (data, tools and services). J. Mariani is a member of the Steering Committee of the network, which has 98 institutional members and 398 research associates. He was responsible for the Evolving Roadmap Workpackage analyzing the language and topic diversity of Language Resources. In this context, he conducted an international overview of Language Resource programs after having established a network of 103 national contact points to provide reliable information. This report is now online as a wiki, which can be updated continuously. J. Mariani has participated in the drafting of the "FlaReNet Book of Recommendations: Language Resources for the Future - The Future of Language Resources", and of the FLaReNet Databook. He also helped organizing the Vienna (2009), Barcelona (2010) and Venice (2011) Forums, and a series of two workshops on Less-resourced Languages as part of the L&TC conference in Poznan in November 2009 ("Getting Less-resourced Languages on-Board") and November 2011 ("Addressing the Gaps in Language Resources and Technologies").

IMMI is also part of the European Network of Excellence T4ME (Technologies for a Multilingual Europe), which was launched in February 2010 and has since then established META-NET[5] (the Multilingual Europe Technology Alliance Network). As of June 2012, this network comprises 60 research centers in 34 countries, and has strong links with three EC projects (PSP METANET4U, META-NORD and CESAR). J. Mariani is a member of the T4ME META Council and of the META-NET Executive Board. He is a founding member of the META-TRUST association.

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[5] http://www.meta-net.eu/
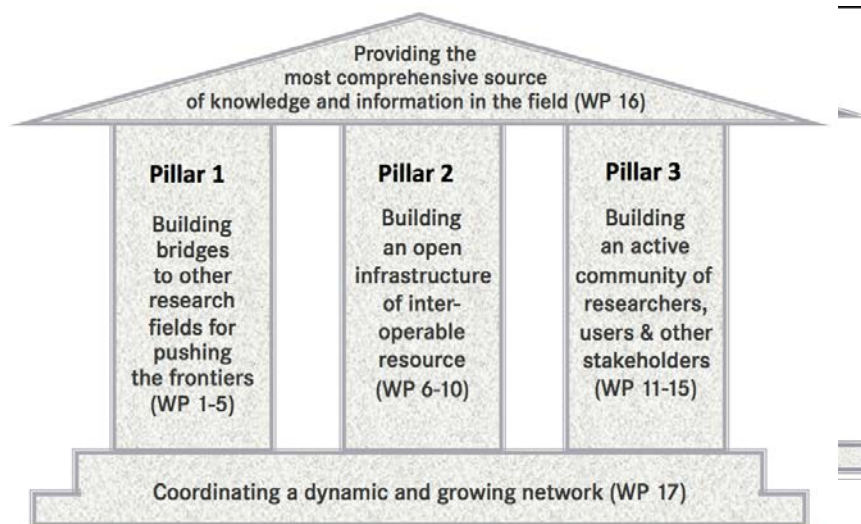
Fig. 2. Architecture of the T4ME EC project.

IMMI through LIMSI and RWTH, participates in the research activities (META-RESEARCH): in the Workpackage lead by LIMSI since 2011 which studies the use of context to improve the quality of Machine Translation, and in the Workpackage on empirical methods, through RWTH. It is involved in the establishment of the Open Infrastructure for sharing Language Resources (META-SHARE), where Gil Francopoulo especially brings his expertise on metadata. It finally intervenes in activities related to the promotion of this research area and to its organization for the coming years (META-VISION).
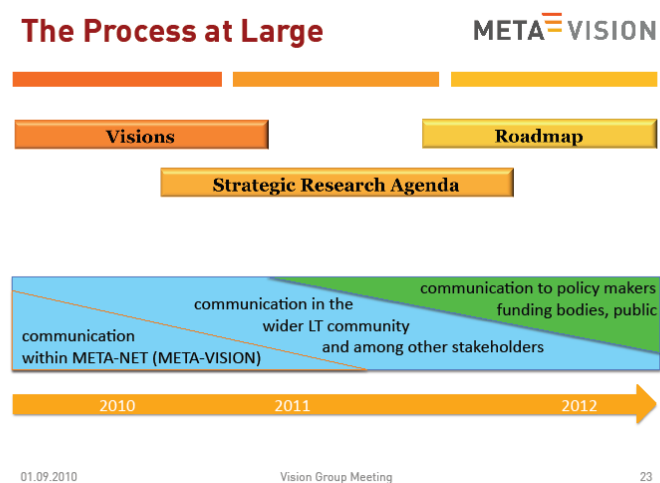
Fig. 3 The META-Vision process

It has the responsibility of the Workpackage aiming at Charting the Field, through the implementation of Language Matrices, providing a comparative survey of Language Resources for each of the existing European languages, the identification of gaps, the writing of a report on national programs on Language Technologies and the production of a series of 31 Language White Papers outlining the characteristics, status and availability of resources and technologies for 31 European languages, to be published by Springer in 2012.

J. Mariani coordinated the Interactive Systems Working Group, and contributes to the drafting of the Strategic Research Agenda (especially on the Socially Aware Interactive Assistants theme) which will be submitted to the European Commission for preparing the next Framework Program for Research and Development Horizon 2020, where IMMI wishes to encourage at the European scale the wide use of objective and quantitative system performance assessment to support research.

International

Internationally, IMMI is particularly active in the European Language Resources Association (ELRA) [6], in which J. Mariani was elected honorary president in 2010, and in organizing the LREC conference (Language Resources and Evaluation Conference) series, which gathers every two years over 1,000 researchers in the field. IMMI held in December 2010 in Paris the International Workshop on Spoken Language Translation (IWSLT 2010) (J. Mariani and A. Waibel co-chairs of the workshop, F. Yvon co-chair of the Program Committee and M. Garnier-Rizet President of the Organizing Committee). It is now in charge of organizing the International Workshop on Spoken Dialog Systems (IWSDS 2012) in November 2012 in Paris.

IMMI also helped organizing the first Tralogy[7] (Translation and Technology) conference enabling the meeting of professional translators, researchers in Machine Translation and trainers of translators. The conference, organized in collaboration with the representative in France of the European Commission, INIST, University Denis Diderot and the French Society of Translators (SFT), was held in March 2011 in the Auditorium of the CNRS Headquarters. Building on its success, a second conference Tralogy II "Finding the way: where are our shortcomings and our individual needs?" is being prepared for January 2013, involving the same partners.

J. Mariani participated in several initiatives of the global network for language diversity MAAYA[8] created by UNESCO as a follow-up of the World Summit for the Information Society. He gave a talk at the International Forum on Multilingualism in Bamako, where a manifesto on Language Diversity was drafted, and at the International Symposium on Multilingualism in Cyberspace (SIMC) in November 2011 in Brasilia. He wrote a chapter in the "Towards the Multilingual Cyberspace" bilingual book released in March 2012.

Alex Waibel, associate director of IMMI, also runs InterACT, an international network of laboratories supporting an exchange program on interactive systems that brings together seven universities all over the world. After IMMI in 2010, InterACT organized IWSLT'2011 in San Francisco in December 2011.

Perspectives

The creation of IMMI and IMMI-Labs took effect on January 1st, 2008. Their activities have been favorably evaluated by the National Committee for Scientific Research at its Fall 2011 session for a renewal over the 2012-2015 period. OSEO has agreed to extend the Quaero program until the end of 2013.

IMMI will devote this period of time to prepare its future, strongly linked to the follow-up of the Quaero program. The construction of a new building and the acquisition of computer facilities will allow for benefiting from a framework to grow its research area in the context of LIMSI. The exchange program of German researchers, made possible by the availability of temporary premises, began to develop in the context of jointly conducted research. The core technologies resulting from research will feed innovative new applications, especially taking benefit of an increasing quality in multilingual Automatic Speech Transcription and Machine Translation.

It is hoped that the establishment of a European network and the drafting of a Strategic Research Agenda will result, in the next Framework Program of the European Commission, in creating a real European Research Area in Language Science and Technology, that could allow for generalizing multilingualism in Europe and in the world, by combining the efforts of the Commission, the Member States and the regions, and possibly of other partner countries.

Staff

J. Mariani (Director), A. Waibel (Associate Director), J.L. Gauvain (Scientific Director), H. Ney (Scientific Director), M. Garnier-Rizet (Coordination of Scientific Information), L. Barreteau (Management and Communication), A. Azhar (Computer Systems), G. Francopoulo (Expert Researcher), J. Temem (Short Term Engineer for Web Communication).

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[6] http://www.elra.info/
[7] http://www.tralogy.eu/
[8] http://www.maaya.org/

Research Conventions and Contracts

Acronym	Funding agency/Partner	Program	Nature	Resp. for LIMSI	General coordinator	Starting date	Ending date	LIMSI share
QUAERO	OSEO		Research contract	J. Mariani	J. Mariani	01/04/2008	31/12/2013	1870000

Scientific Publications

Articles and chapters in books

A1.　Mariani, J.-J., *Les recherches en technologies de la langue pour soutenir le multilinguisme.* Culture et Recherche - Diversité des langues et plurilinguisme, 2011. (124): pp.45-47.

A2.　Mariani, J.-J., *Les technologies de la langue en soutien au multilinguisme*, in *Forum International de Bamako sur le Multilinguisme*, A. Samassekou, Editor. 2011, ACALAN. pp. 125-133.

A3.　Samassekou, A., J.-J. Mariani, and et al., *Engagement de Bamako pour un multilinguisme universel et plan d'action*, in *Forum International de Bamako sur le Multilinguisme*, A. Samassekou, Editor. 2011. pp. 29-36.

Communications

C1.　Calzolari, N., K. Choukri, B. Maegaard, J.-J. Mariani, J. Odijk, and S. Piperidis. *Closing remarks.* in *International Conference on Language Resources and Evaluation.* 2010. Valetta, Malta.

C2.　Calzolari, N. and J.-J. Mariani. *Introduction of the international cooperation session.* in *FLaReNet Forum 2010.* 2010. Barcelona, Spain.

C3.　Calzolari, N. and J.-J. Mariani. *The FLaReNet Community: the Way Forward.* in *FLaReNet Forum 2011.* Venice, Italy.

C4.　Choukri, K., J.-J. Mariani and Z. Vetulani. *Addressing the gaps in language resources and technologies.* in *Language & Technology Conference: Human Language Technologies as a Challenge for Computer Science and Linguistics.* 2011. Poznan, Poland. p. 34.

C5.　Mariani, J.-J. *Closing Remarks.* in *HLT Baltic Conference.* 2010. Riga, Latvia.

C6.　Mariani, J.-J. *International Language Resources Mapping.* in *Oriental COCOSDA.* 2010. Katmandhu, Nepal.

C7.　Mariani, J.-J., *Speech and language technologies frameworks in the European research area*, in *Multisaund seminar* 2010, Istanbul, Turkey.

C8.　Mariani, J.-J., *Presentation of IMMI*, in *Multisaund seminar* 2010, Istanbul, Turkey.

C9.　Mariani, J.-J., *Language resources and evaluation in Europe: an historical perspective*, in *Séminaire DGA/DET/CEP* 2010.

C10.　Mariani, J.-J., *Pour une éthique de la recherche en sciences et technologies de l'information et de la communication*, in *Présentation publique CNRS-Comets/INRIA* 2010.

C11.　Mariani, J.-J., *IMMI, Quaero, Language Resources and Evaluation*, in *Interact Presidential Summit* 2010, CMU, Palo Alto, USA.

C12.　Mariani, J.-J. *LT2020 vision: interactive systems.* in *Language & Technology Conference: Human Language Technologies as a Challenge for Computer Science and Linguistics.* 2011. Poznan, Poland.

C13.　Mariani, J.-J. *Opening Remarks.* in *Oriental COCOSDA.* 2011. Hsinchu, Taiwan.

C14.　Mariani, J.-J. *The Future European Multilingual Society.* in *META-FORUM 2011.* Budapest, Hungary.

C15.　Mariani, J.-J. *European Activities in Language Technology, in the Perspective of FP8.* in *Speech Processing Conference 2011.* 2011. Tel Aviv, Israel.

C16.　Mariani, J.-J. *A Journey from the LRE Map to the Language Matrixes.* in *FLaReNet Forum 2011.* Venice.

C17.　Mariani, J.-J. *Introduction of the Identification and Tracking of Language Resources Session.* in *FLaReNet Forum 2011*, 2011, Venice, Italy.

C18.　Mariani, J.-J., *Pour une éthique de la recherche en sciences et technologies de l'information et de la communication*, in *Grands Débats Ethiques de l'ICT* 2011, Institut Catholique de Toulouse.

C19.　Mariani, J.-J., *The Future European Multilingual Society*, in *Multisaund Seminar* 2011, Bursa, Turkey.

C20.　Mariani, J.-J. *L'apport des technologies de la langue au multilinguisme.* in *Etats Généraux du Multilinguisme dans les Outre Mer.* 2011, Cayenne.

C21.　Mariani, J.-J. *Les possibilités offertes par les technologies de la langue pour améliorer la relation aux usagers dans les services publics.* in *Etats Généraux du Multilinguisme dans les Outre Mer.* 2011, Cayenne.

C22.　Mariani, J.-J. and C. Soria. *Identifying and Networking Forces: an international panorama.* in *FLaReNet Forum 2011.* Venice, Italy.

Research groups presentation

Unsteady Aerodynamics: Turbulence and Control (AERO)

Christian Tenaud

Introduction

Fluid flows are present in a large number of engineering fields such as transport, energy, environment, biotechnology, and health. Most of the fluid flows encountered in these fields of application are unsteady, generally turbulent, and often coupled with other physical phenomena. Mastering and controlling these unsteady flow phenomena then constitutes a major challenge regarding the design, the optimization and the operation improvement of the fluid systems. Research conducted in the "Unsteady Aerodynamics: Turbulence and Control" group aims at both improving the prediction capabilities of numerical simulations by development of high performance computational methods and developing new methods for analysis of flow dynamics in view of more effective fluid flow control. The fluid flows that are considered by the group are most often dominated by convection (high Reynolds flows). Associating the triptych modeling / simulation / experiment, the group seeks to achieve two main objectives. The first objective, fundamental, focuses on the prediction, the analysis, the understanding, and the control of elementary phenomena in fluid dynamics by advancing the knowledge at large and setting bases for future technological breakthroughs. The second objective, more applied, consists in using the acquired knowledge to simulate real life flow problems to meet the technological challenges raised by human societies.

The group gathers skills in modeling, scientific computing, applied mathematics, experimentation, and fluid flow control. The scientific coherence is maintained by strong interactions between theoretical works, numerical simulations, and experiments. For instance, data retrieved from experiments and numerical simulations are compared to validate modeling and to characterize the dynamical behavior. The accuracy and efficiency of numerical tools designed in the group are constantly assessed trough numerical tests and rigorous numerical analysis. The quality of experimental measurements is also guaranteed by a constant search for new non-intrusive experimental protocols.

The group is organized around three main themes:

Efficient numerical methods: The objective of the theme is to increase the capabilities of the numerical simulations, developing more accurate, reliable, and efficient computational methods, to reproduce with higher fidelity physical phenomena and then to better address the complexity due to either geometrical aspects or multi-physics flows. The central subjects considered in this theme, deal with the resolution of partial differential equations describing fluid flow dynamics, high order numerical schemes and sub-grid modeling in Large Eddy Simulation (LES), the processing of unsteady boundary conditions, and the quantification and the propagation of uncertainties.

Unsteady flows: This theme focuses on the physics of fundamental unsteady flows. It aims at understanding the basic phenomena through the characterization of coherent structures for a better understanding and meaningful analysis of the flow dynamics. This is achieved by associating efficient numerical simulations and innovative experimental methods with advanced dynamical analysis tools. Extraction of coherent structures, characterization of their dynamics and the coupling between turbulent structures and unsteady pressure field are mainly studied, within highly unsteady or largely separated flows.

Manipulation and flow control: This theme aims at studying, mostly at a methodological level, manipulation techniques and control methods to improve flows for energy savings (drag reduction, mixing enhancement, wall energy transfer…). Reduction of the dynamics, prediction through integration of dynamical systems for real-time control, estimation and manipulation of the flow in wall regions, synthesis of control laws and development of closed loop strategies are among the principal topics considered in the theme.

Most of our research activities are funded through research grants, in particular by the Agence Nationale de la Recherche (ANR) and RTRA fundations; for instance the group had 4 ANR projects (one as leader) and 3 RTRA DIGITEO grants running during the period 2010—2011. Part of our work is carried out in collaboration with groups in laboratories belonging to CNRS or the French Universities (Pprime Institute, Poitiers; EM2C Châtenay-Malabry; GEM, Nantes; LMO, Orsay; Camille Jordan Inst., Lyon; LJAD, Nice; CERMICS, Marne-La-Vallée; SATIE/ENS, Cachan; PMMH/ESPCI, Paris; LTPM, Grenoble; DYNFLUID, Paris; GIPSA-lab Grenoble) or to the foreign Universities (Texas A&M University, College Station, USA; Johns

Hopkins University, Baltimore, USA; MEMS, Duke University, USA; Florida State University, Tallahassee, USA; Sandia National Labs., Livermore, USA; LFD, Universidad de Buenos Aires, Argentine; Grupo de Mecânica dos Fluidos, Universidade de Coïmbra, Portugal; Polish Academy of Sciences, Warszawa). We are actively involved in the scientific activities of the Franco-Argentine International Associated Laboratory "Physics and Fluid Mechanics" (LIA PMF) through topics related to the analysis, modeling and control of fluid flows.

Research presentation

Topic 1: High Performing Numerical Methodologies

O. Le Maître, *V. Daru, Y. Fraigneau, L. Mathelin, B. Podvin, and C. Tenaud. PhD students and Post-Doctoral fellows: S. Bensmina, L. Monasse, J. Pebel, A. Perrera, A. Puscas, A. Tassi, and J. Tryoen*

Numerical methods for highly accurate fluid flow predictions *(S. Bensmina, V. Daru, Y. Fraigneau, L. Monasse, B. Podvin, A. Puscas and C. Tenaud)*

Computer power has considerably increased during the last decades. For fluid dynamic problems, this has motivated developments of high-order numerical methods to increase the prediction capability of numerical software. Direct Numerical Simulation (DNS) rapidly became a powerful tool for performing fine analysis of flow dynamics [Moin & Mahesh, 1998] since all the length-scales are represented in the simulation. On the one hand, the quality of the results mainly depends on the capability of the numerical scheme to capture the governing dynamical process. In this context, we developed over the last years high-order numerical approximations that can both represent small-scale structures with the minimum of numerical dissipation and capture with robustness the compressible features responsible for discontinuity creation [Daru & Tenaud, 2004, 2009]. On the other hand, the quality of solutions also depends on the capability of the computational grid to capture all the length-scales involved in the dynamical mechanisms. We then implemented Adaptive Mesh Refinement techniques for problems exhibiting locally steep gradients or shock-like structures. In the past, classical AMR techniques have been derived. However, the refinement criterion used in AMR approach refers neither to the quality of the solution nor to an error norm of the solution. To overcome this well-known problem, Adaptive MultiResolution methods (MRA), based on Harten's pioneering work [Harten, 1995], have been employed here to compute multidimensional hyperbolic conservation laws as well as reaction-diffusion problems in the combustion framework [Tenaud & Duarte, 2011]. We evaluate through well known test-cases the capability of the MultiResolution coupled with high resolution spatial and temporal approximations to recover elementary physical mechanisms (Illustration 1) by achieving gains in both CPU time and memory usage compared to single grid computations [L. Bentaleb et al., 2005; Tenaud & Duarte, 2011]. A software named *MR_CHORUS*, based on the MRA technique coupled with the OSMP schemes developed at LIMSI, has been written to perform DNS of unsteady compressible flows. A license has been filed (DI 03760-01) for MR_CHORUS. This software starts to disseminate in the CFD community since a collaborative work with EM2C (UPR CNRS 288), in the MUSE Project of the RTRA DIGITEO, has recently been undertaken on coupling space Adaptive MultiResolution with a new resolution strategy based on time operator splitting in the context of very localized and stiff reaction fronts. This strategy thus leads to a time splitting algorithm which is not restricted by either the fastest scales in the source term or the stability constraints of the diffusive steps but only by the physics of the phenomenon [Duarte *et al.*, 2012]. This strategy aims at solving complete models including all time and space scales within a prescribed accuracy,
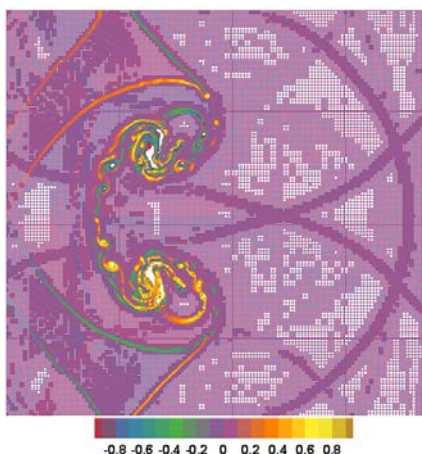
Illustration 1 – Interaction of a high density bubble with a Mach 2 steady shock wave at a dimensionless time t = 0.8: Vorticity contours colored onto the refined grid downstream of the interaction. Mesh is refined in the vicinity of wave patterns as well as regions exhibiting high vorticity.

considering large simulation domains with conventional computing resources.

In addition to our developments of high accurate approximations on Cartesian grids, we have developed a new conservative coupling algorithm for fluid–structure interaction of deformable moving bodies with a compressible flow (PhD thesis of L. Monasse, in collaboration with CEA-DAM, CERMICS-ENPC). The aim was to simulate transient dynamics problems, such as the impact of shock waves onto a structure, with possible fracturing causing the ultimate breakdown of the structure. The simulation of fluid–structure interaction problems is often computationally challenging since the coupling of the different numerical methods used for solids and fluids often results in numerical instabilities. For the coupling in space, a possible choice is to deform the fluid domain in order to follow the movement of the solid boundary: the Arbitrary Lagrangian–Eulerian (ALE) method has been developed and has widely been used for incompressible [J. Donea et al., 1982; M.A. Fernández et al., 2007] and compressible [C. Farhat et al., 2006] fluid–structure interaction. However, when solid impact or fracture occur, ALE methods are faced with changes of topology in the fluid domain that require remeshing and projection of the fluid state on the new mesh, which are costly and error and diffusion prone procedures. In order to allow for easier fracturing of the solid, we instead chose a method based on fictitious domains that solves the fluid flow on a fixed Eulerian mesh, on which a Lagrangian solid body is superimposed. We developed a new coupling algorithm between a compressible fluid flows and a moving body using an Embedded Boundary method that has the advantage of preserving the usual CFL stability condition: the time-step can be taken as the minimum of the full cell size fluid and solid time-steps. The combination of the Embedded Boundary method for the fictitious fluid domain and of the coupling strategy ensures the conservation of fluid mass and the balance of momentum and energy between fluid and solid. Our results on two-dimensional benchmarks agree very well with body-fitted methods and improve on previous results obtained with Immersed Boundary algorithms [L. Monasse et al., 2012]. Numerical examples suggested second-order convergence of the solid position and super-linear convergence of the fluid state. This algorithm is also capable of dealing with solid boundaries coming close to each other (Illustration 2), which is promising for impact simulations. The method is computationally efficient, as the coupling adds an integration on a space one dimension smaller than the fluid and solid computation spaces. The present method was designed so that it can naturally extend to three space dimensions. This constitutes part of the work undertaken in the PhD thesis of A. Puscas, which is mainly devoted to the numerical treatment of the fracturing of the structure under the impact of shock waves.
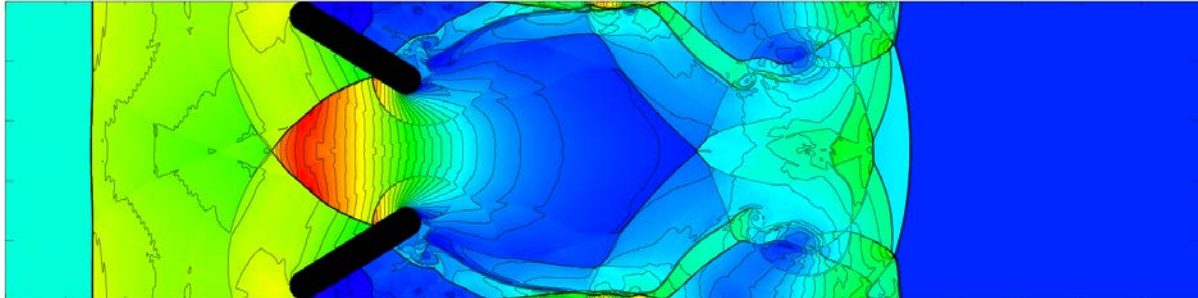
Illustration 2 - Wave patterns produced by the interaction of a strong shock wave with flapping doors: Density contours at time 0.375 s.
L. Monasse, 2011 © collaborative work between CEA-DAM, CERMICS-ENPC, and LIMSI-CNRS.

Large-eddy simulation (LES) has been quite successful for the prediction of large-scale motions in challenging flow conditions such as detachment or shock/shear layer interaction. However it still requires a high resolution near walls, owing to strong velocity gradients and the interdependence of a wide range of scales there, which makes it difficult to use in simulations at large Reynolds numbers. Recent wall modeling techniques are based on a zonal approach, where LES unsteady calculations in the outer layer are coupled with another type of calculation such as URANS in the inner layer [Piomelli et Balaras, 2002]. This is an illustration of a more general situation, which requires the generation of data on a subset of the domain that captures the relevant spatio-temporal features of the flow. A related issue is to estimate the flow from partial measurements and global statistics. Statistics typically consist of the spatial autocorrelation of the flow. This allows us to represent the flow as a superposition of known spatial structures (POD empirical eigenfunctions) whose amplitudes vary in time and constitute the variables to be estimated. Neural estimation techniques have been developed to recover the flow dynamics in both the PhD thesis of L. Lorang-Vo Dinh and the ANR project CALINS. Another idea is to use Linear Stochastic Estimation (LSE). The temporal amplitude of each POD structure is predicted from its individual signature in the space of available measurements. This technique has been used to reconstruct 3D vortices in a cavity flow from a plane of measurements [Podvin et

al., 2006]. More recently, it has been applied to construct synthetic wall boundary conditions for the simulation of channel flow [Podvin et al., 2010]. These synthetic conditions might also be used as actuator conditions for flow control at the wall. Results using such conditions are shown in the theme devoted to flow control (see below).

Numerical methods for uncertainty quantification in fluid dynamics *(O. Le maître, L. Mathelin, J. Pebel, A. Perrera, A. Tassi, J. Tryoen)*

This activity concerns the design of efficient numerical techniques for the propagation of parametric uncertainties in computational models, in particular for the simulation of fluid flows (Navier-Stokes equations, conservation laws, flow in porous media…). The methods developed at LIMSI are probabilistic, the uncertain parameters being characterized by their (joint) probability law, and we seek for a functional representation of the dependence of the model solution (or some quantity of interest) with respect to these random parameters. The functional representation is sought as a projection of the uncertain model solution onto a finite dimensional space spanned but suitably constructed orthogonal (uncorrelated) functionals in the random parameters. Such representation offers the advantage to allow for a fine analysis the respective impact of different uncertainty sources [Crestaux *et al.*, 2009], as well as their interaction, in addition to provide the statistical moments of the solution and its probability law. The computational cost for the determination of the functional representation can be large and depends in practice mainly on the dimension of the projection space and on the complexity of the solution dependence with respect to the random parameters. Consequently, most of our efforts these last years have been dedicated toward the design of computationally efficient methods through the development of adaptive strategies at the stochastic level, reduced basis representations, improved sampling approaches, stochastic preconditioning… Some of these contributions are highlighted below.

Stochastic anisotropic adaptivity: conservation laws and hyperbolic models have the property to develop discontinuities in space in finite time. In presence of uncertainty, these discontinuities travel with uncertain velocity yielding discontinuities in the random parameters domain too. In such a situation, expansions in terms of smooth (spectral) functionals are inefficient and one needs to use instead piecewise smooth approximations. In the thesis of J. Tryoen (2008-2011), with co-advisor A. Ern at CERMICS ENPC, a multi-resolution framework has been proposed together with an adaptive algorithm for the control of the local stochastic resolution. In this approach, the projection coefficients are computed by means of Galerkin procedures, leading to the resolution of an extended system of conservation law. Since this system has a solution that is spatially discontinuous, a Roe-type solver has been proposed in [Tryoen *et al.*, 2010a], together with an entropy corrector [Tryoen *et al.*, 2010b]. Different criteria have been proposed, based on theoretical considerations, for the stochastic adaptation. Here, we exploit the localized character of the discontinuities to refine the stochastic discretization only where necessary in space and time, and in an anisotropic fashion in the stochastic domain since the solution can be discontinuous with respect to some random parameters and smooth with respect to others. The adaptive scheme and the Roe-type solver have been applied to the propagation of uncertainties in the Burger, traffic and Euler equations (Illustration 3), and for up to 6 uncertain parameters [Tryoen *et al.*, 2011, Tryoen *et al.*, 2012].
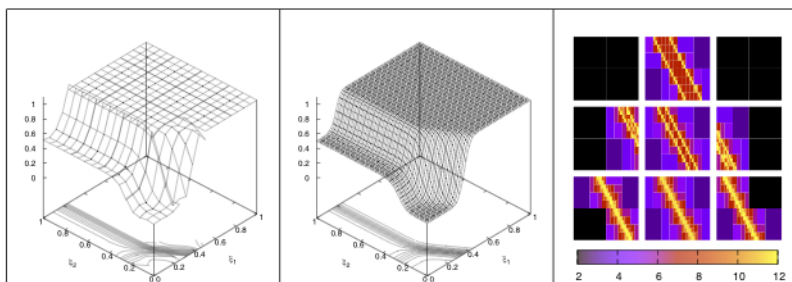
Illustration 3 - Stochastic Burger equation. Solutions at a point (x,t) as a function of 2 random parameters and for uniform resolution levels 2 and 4 (left plot). Color-coded adapted stochastic resolution for a traveling shock, as a function of time -top to bottom- and at 3 spatial locations -left to right- (right plot).

Reduced bases: stochastic Galerkin methods use classically an a priori selection of the expansion basis constituting the projection space, and the size of the Galerkin problem scales with the dimension of the projection basis. In collaboration with A. Nouy (GeM, Ecole Centrale de Nantes) we have derived reduced basis approximation techniques for the approximation of the Galerkin solution, through Proper Generalized Decompositions. Here, the stochastic functional are not selected a priori but are determined sequentially to minimize the stochastic Galerkin residual. We have proposed and tested several algorithms to construct this reduced basis, with a special emphasize on applications to non-linear models arising in fluid mechanics,

namely Burgers equations, non-linear porous media [Nouy and Le Maître, 2009] and more recently the incompressible Navier-Stokes equations [Tamellini et al., 2012]. One very interesting by product of the proposed construction methods is that they lead to the resolution of sequence of problems whose structure is very similar to the initial deterministic problem, thus easing the reuse of existing numerical codes. In fact, for the most efficient algorithm the determination of the N-term reduced approximation has a cost of N deterministic simulations, with up to two orders of magnitudes in computational times reduction. Current works on the reduced basis concern the extension to unsteady [Mathelin et al., 2009] and coupled problems.

Stochastic preconditioning, asynchroneous integration and multiscale problems: many uncertain models exhibit complex dependences with respect to the random parameters, thus necessitating high-order expansions when stochastic polynomial bases are used. This is typically the case when the characteristic time-scales of the solution are affected by the uncertainties. We have tackled these situations through different approaches, all aiming at achieving representation in low dimensional stochastic spaces and so at a reduced cost. In [Alexanderian et al., 2012], we have proposed to precondition the stochastic projection, in a non-intrusive (sampling) framework, by an invertible transformation of the model solution. With a suitable generic transformation, we have shown that the polynomial degree needed could be decreases significantly, with large computational savings as a result. In [Le Maître et al., 2010a], the case of dynamical systems with almost surely periodic dynamics was considered in the Galerkin framework. Here, a stochastic transformation of time is computed, by solving an additional control problem, to maintain all realizations of the stochastic system essentially in phase, therefore preventing the need of an increasing polynomial degree as time advances. This method is currently applied to the Navier-Stokes equations for uncertain unsteady flow around a cylinder with random fluid viscosity and inflow velocity [Schick and Le Maître, 2012]. The more complex situation of stiff systems with uncertain broad range of time-scales has been considered in [Salloum et al., 2012], where the deterministic Computational Singular Perturbation method has been extended to the uncertain case. This method relies on a separation of the dynamics in slow and fast uncertain time-scales, with associated uncertain manifolds. The dynamics is then time-integrated exactly in the slow stochastic manifold, and projected on the fast uncertain manifold. This allows both reducing the polynomial degree of the approximation and alleviating the severe constraint on the time-step required for stable explicit time-integration.

The developments made at LIMSI on these stochastic approaches have lead to the publication of the reference book Stochastic Spectral Methods for Uncertainty Quantification, with applications to CFD, by O. Le Maître and O. Knio, published by Springer in 2010.

Topic 2: Unsteady Flows

F. Lusseyran, N. Delprat, V. Daru, T. Faure, Y. Fraigneau, L. Pastur, S. Pellerin, B. Podvin, D. Sciamarella, C. Tenaud. PhD students and Post-Doctoral fellows: P. Debesse, J. Basley, C. Douay, F. Guéniat, J. Pinto, T. Rouillon, and F. Silva

Relevant characterization and analysis of unsteadiness is still a challenging task in fluid mechanics. The group develops internal joint know-how in numerical simulation, experiments and signal processing in order to capture the main characteristics of the time-space behavior of more or less organized flows.

Flow analysis and reduction of the dynamics *(N. Delprat, T. Faure, Y. Fraigneau, F. Lusseyran, L. Pastur, J. Basley, C. Douay, F. Guéniat; in collaboration through the LIA PMF and the STIC-AmSud program, with G. Artana and A. Cammilleri (LFD, UBA), J. Carlier and E. Memin (FLUMINENCE, INRIA)*

The interaction of a boundary layer with an open cavity is encountered in many real configurations, for instance in transport engineering (pantograph cavity on a TGV, opened side window or roof on a car …) or in environment field (street canyon within the canopy) as well as in biotechnology and health (glottal flow configuration). In this generic flow configuration the interaction between the boundary layer and the flow within the cavity produces large unsteadiness that must be studied since they are mainly responsible for noise production as well as containment (and deconfinement) of the inner flow that, for instance, is an important issue for pollutant contamination in some applications. The work undertaken for several years is conducted in the frame of several projects (ANR DIB & CORMORED, DIGITEO Fluctus & Muse) and supported by DGA & CNRS grants of two PhD Thesis of J. Basley and C. Douay.

In the last years, we focused our attention on three specific axes that mainly concern a detailed analysis of the flow structures, tool developments for coherent flow structure identification, and development of modal decompositions for a better understanding of the space-time non-linear dynamics:

- Regarding values of the control parameters (Reynolds number, aspect ratio, cavity depth), a spanwise alley of pairs of counter-rotating vortices, forming vortical torus-like structures around the main inner

recirculation flow, may develop due to centrifugal instabilities. Depending on conditions imposed at both spanwise boundaries, the dynamical features of individual pairs may change. When boundaries are rigid (experimental and DNS analysis), pairs of vortices drift toward one wall or the other, depending on their initial position inside the cavity, as the result of an Eckman pumping effect close to end-walls. When boundary conditions are periodic (DNS analysis), the basic structure is steady (see Illustration 4-a) and may become unsteady as the Reynolds number increases. In this configuration, we determined the stability properties of a two-dimensional steady base state, with respect to spanwise perturbations, and found three branches of growing modes recovered in the permanent (fully non-linear) regime. Experimentally, we initiated the parametric study of bifurcations encountered in the inner flow, varying both the Reynolds number and the cavity aspect ratio, and conducted a comparison with numerical results.

- To educe coherent structures, criterions must be found since no definition is unequivocal. We worked on detection and tracking of Eulerian and Lagrangian coherent structures. Following the Finite Time Lyapunov Exponents (FTLE) technique, divergence and contraction rates of the flow trajectories are determined. Ridges of the scalar field made of local divergence rates can be defined as (quasi) Lagrangian structures that are surfaces embedded in the fluid through which the flow rate vanishes. This work is conducted in the frame of projects DIGITEO, Fluctus and ANR DIB, in collaboration with LRI (Orsay), Pprime (Poitiers) and PSA. Optimized software, based on hybrid computer configuration (GPU / CPU), has been developed for FTLE calculation of 2D and 3D velocity fields (illustration 4-b and c) that achieves impressive gain on CPU time.

- Modal decompositions have also been employed to analyze and educe the dynamic behavior of the flow. Power spectral densities evolve with the control parameters. Regimes of shear layer oscillations were investigated together with dynamic modes associated with the main spectral components. Hence, coherent structures have been identified for the permanent regime of the velocity field obtained through both experimental (PIV and TR-PIV) measurements and numerical results, by using proper orthogonal decomposition (POD), global Fourier modes or dynamic mode decomposition (DMD). Part of this study has been funded by an internal initiative financial support held by Nathalie Delprat & Luc Pastur and the CNRS & DGA grant for the PhD Thesis of Jérémy Basley.
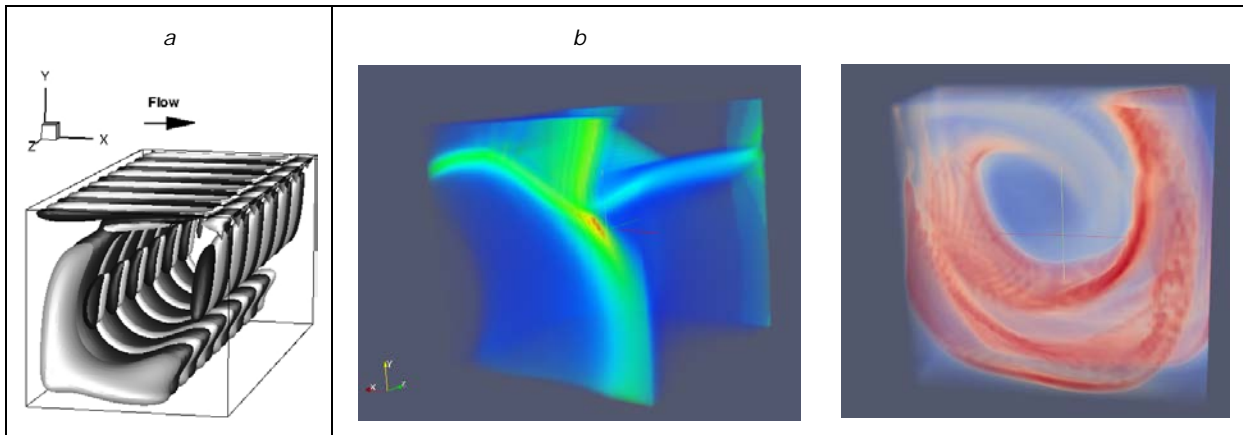
Illustration 4: Open cavity flow 3D DNS a) centrifugal instability, b) 3D FTLE fields from the DNS flow.

To derive low order dynamical models that are able to mimic the complex dynamical behavior of unsteady flows, work on modal decomposition must be undertaken. In collaboration with G. Artana, in the framework of the LIA PMF, we have developed an algorithm that combines Proper Orthogonal Decomposition with spectral methods (namely Dynamic Mode Decomposition) to analyze and extract reduced order models from time data series of velocity fields. Flows under consideration are assumed to be driven by non-linear dynamical systems exhibiting a complex behavior. Model reduction relies on both energetic and spectral criterions, something required when dynamical features that are energetically not significant may be lost. For instance energy sinks are usually associated with fine structures whose energetic contribution is negligeable compared to dominant structures at lower scales. As a consequence, reduce order models may blow up on finite time scales due to energy accumulation. One major advantage of this method is that prediction of further states does not require time-integration anymore since it simply relies on matrix multiplication allowing real time prediction in models with hundreds of degrees of freedom. In addition, since spectral modes are associated with eigen-values lying on the unit circle, such models are guaranteed not to blow up

over time scales several times larger than the observation time range. This approach has been checked with success on data obtained from time resolved PIV of a cylinder wake flow at a Reynolds number of 3900.

Dynamics, Unsteadiness and Noise around a blunt flat plate (Dynamique, Instationnarité et Bruit, DIB ANR Project*) (P. Debesse, T. Faure, Y. Fraigneau, F. Lusseyran, L. Pastur and C. Tenaud)*

The ANR project DIB consisted in the quantitative analysis of unsteady aerodynamic fields and their associated sound production mechanisms. The corresponding aerodynamic systems are characterized by regions of fully separated turbulent flow and strong flow-structure interaction. A fundamental understanding of such flows is a major scientific challenge for ground vehicle transportation for instance, where security (vehicle stability) and environmental concerns (noise production, both internal and external and chemical pollution, highly related to drag reduction) are involved. Our contribution in the ANR DIB project dealt with: - the quantitative analysis of the main mechanisms involved in unsteady Aero-Acoustic flows, - creation of both experimental and numerical databases (DNS of an open cavity and of a blunt flat plate, Illustration 5-a), and - the development of analysis tools, for instance, (i) the development of an original and optimized algorithm of Lagrangian flow structures identification (Finite Time Lyapunov Exponents) allowing FTLE computations on 2D PIV measurements and 3D LES, (ii) the dynamic mode analysis of the forward-facing blunt flat plate flow (Illustration 5-c), compared to the POD modes (Illustration 5-b), that allows us to explain the connection between the steady field and the acoustic far field, and (iii) the synchronized measures between wall pressure fluctuations and the velocity field in the open cavity at low Reynolds numbers.
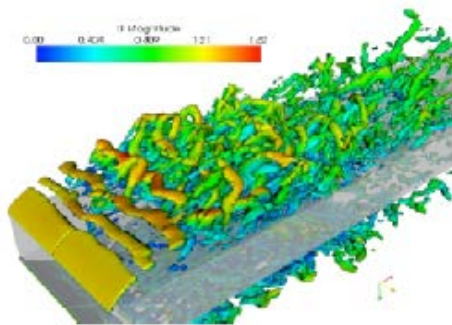
a)

Illustration 5: Numerical predictions through Large-Eddy Simulation (LES) of the separated—reattached turbulent flow over a blunt at plate:

a) Snapshot of an iso-surface of the Q criterion (Q=3) colored with the norm of the velocity.

b) Most typical POD mode.

c) Real-part of the dynamic mode associated with the 3rd main frequency f3 = 1693 Hz.
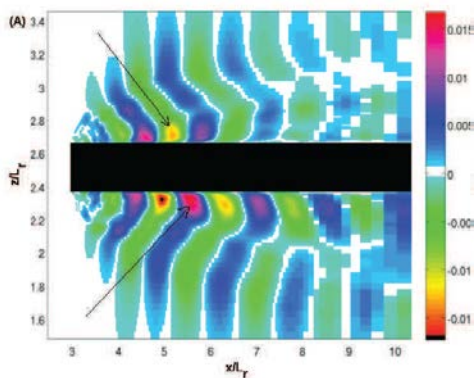
b)
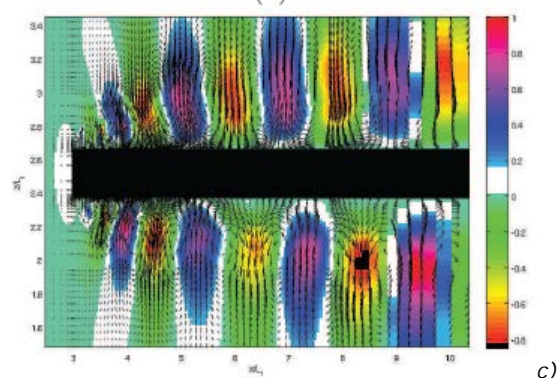
c)

Pulsating Jets and Voice Production (D. Sciamarella and Y. Fraigneau in collaboration with G. Artana, Univ. of Buenos-Aires through the LIA PMF with a post-doc 2010-2011: F. Silva.)

Glottal flow is the pulsating air jet generated by a couple of self-oscillating structures in the larynx: the vocal folds. Unveiling the mechanisms involved in the production and development of this biological flow are of interest for the physics of vocal production, for the assessment of the dynamics and topology of the processes governing high-aspect ratio pulsating jets, and for the development of flow control applications based on bio-inspired devices. Our work has two phases: a numerical phase, in which the flow is studied using direct numerical simulations, and an experimental phase developed at the LFD, a partner laboratory of LIMSI in the Franco-Argentinian International Associated Laboratory in the Physics and Mechanics of Fluids (LIA PMF).

In 2010-2011, the focus was put on three-dimensional flow generated with two different configurations. In the first configuration, the flow is a pulsating jet generated by an external modulation at a frequency of about 100 Hz controlled by a valve developed by Sciamarella and Artana to reproduce the glottal flow waveform (Illustration 6-a) (a patent is under consideration by CNRS). In the second configuration, the flow is generated by a couple of self-oscillating water-filled latex lobes (Illustration 6-b) imitating vocal fold motion during phonation. The flow was studied experimentally using the Stereo-PIV technique. Two students, F. Krebs and P. Dörr completed their engineering diploma thesis under the supervision of Sciamarella and Artana. A third student, A. Centeno has initiated an engineering diploma thesis on the same subject. A post-doctoral student with the Bernardo Houssay scholarship, F. Silva, worked on the post-treatment of the data acquired in the experiments. These studies have led to the first three-dimensional reconstruction of space-time dynamics of this type of flow, an achievement that was central to gain insight into the fluid-dynamical mechanisms in play during vocal fold vibration. On the other hand, the results have shown that the mean flow presents self-similarity properties that come out when a similarity analysis is performed along the planes containing the major and minor axes of the glottal outlet. The collapsing profiles are compatible with a velocity field in which the orientation of the symmetry axes changes with the distance to the jet exit (axis switching, Illustration 6-c).

False vocal folds define a constriction in the larynx downstream of the time-varying constriction defined by the vocal folds. This configuration corresponds to two mirrored cavities, placed face to face. Preliminary measurements were done in 2011 upon a system made up of two rectangular cavities schematically reproducing the ventricle defined by the false vocal folds in the larynx. A PhD thesis project with the title «Estudio del comportamiento del flujo en un canal con dos cavidades enfrentadas» has been retained by CONICET (Argentine) for a student (F. Tuerke) that will work on this subject in the context of the LIA PMF.

(a)   *(b)*   *(c)*
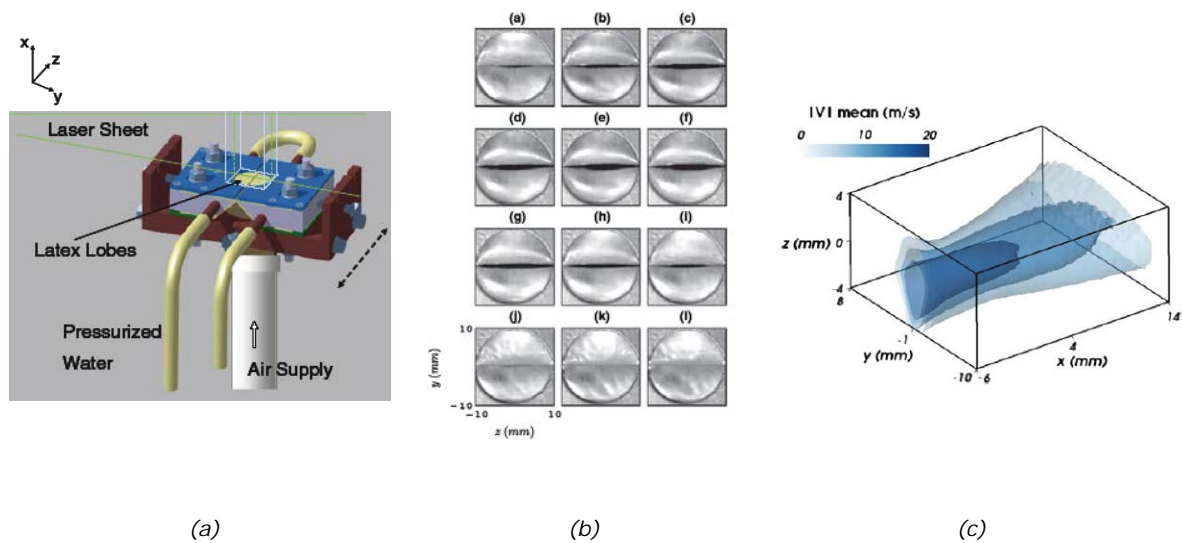
Illustration 6 - (a) Configurations used for the stereoscopic PIV measurements of self-sustained glottal-like flow, (b) Top views of a typical oscillation cycle of the water-filled folds, (c) Three-dimensional reconstruction of the mean flow.

Topic 3: Manipulation and flow control.

B. Podvin, L. Mathelin, *T. Faure, Y. Fraigneau, O. Le Maître, F. Lusseyran, L. Pastur, S. Pelleri and C. Tenaud. PhD students and Post-Doctoral fellows: E. Atam, J. Basley, C. Douay, and T. Rouillon*

Global optimization of vortex generator parameters for drag reduction of ground vehicles. *(T. Rouillon, L. Mathelin and C. Tenaud in collaboration with F. Harambat (PSA) through a CIFRE PhD thesis).*

Reduction of pollutant emissions is one of the major objectives in the industrial world. For an automobile vehicle on highway, 70% of energy waste is due to the total drag and 80% of it arises from the pressure drop within the boundary layer separation. This explains why the reduction of the total drag is one of the main issues in transport industry. The adverse pressure gradient at the rear-end of the car has a major role in flow separation and hence constitutes the motivation for the present work that aims at studying different ways to manipulate this flow separation. Here, we focus on manipulation using small fins called Vortex

Generators (VGs) that could be arranged on the car wall. VGs locally create counter-rotating vortex pairs that inject momentum from the high-speed outer part of the boundary layer to the low velocity inner region. The boundary layer is then less prone to separation. In this work, an optimization loop is proposed, associating a RANS numerical solver and an optimizer, to determine the best set of VG parameters (Illustration 7) to reduce the drag of an academic geometrical configuration. The geometry however represents a simplified rear part of a car (Illustration 7). To prevent fine-grained meshing in the VG vicinity, and hence a prohibitive CPU time consumption, source terms (BAY model, [Bender et al. (1999)]) are used that substitute meshing the VGs with a lift force. Both a response surface-based optimizer and a geometrical optimizer are compared with evolutionary-based and gradient-based techniques on an analytical function and shown to achieve good results with a fewer number of evaluations. They are then used to find the best set of VG parameters to control the flow over the geometry. A 25 % reduction of the drag is here achieved by using a global optimization (Illustration 8).
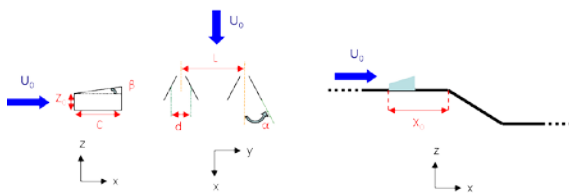
Illustration 7 - Vortex generator parameters and dihedron configuration
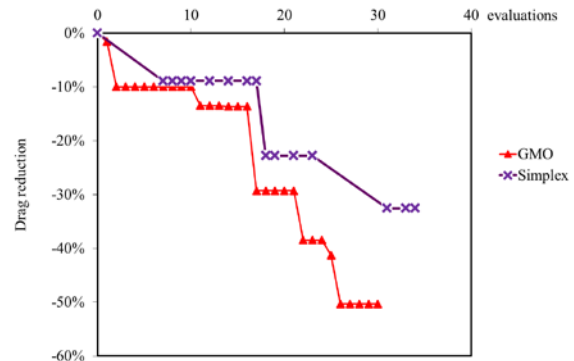
Illustration 8 - Drag reduction on a dihedron configuration representing the rear-part of a car: Comparison between a Simplex method and a global optimizer (the EGO method).

Synthetic wall boundary conditions for direct simulation of wall turbulence *(B. Podvin and Y.Fraigneau)*

It is well known that simulations of wall turbulence at high Reynolds numbers require a large number of points to adequately resolve the wall region. A considerable effort has been made to alleviate this restriction through the development of wall models, which have led to hybrid RANS/LES simulations and multi-zone approaches. Here we explore an alternative route that is based on the 3-D POD of the flow. We consider the simulation of a turbulent channel flow in a restricted domain, i.e., where the region $y^+ < y_0$ is replaced with a Dirichlet boundary condition for the velocity field at $y^+ = y_0$. A major assumption is that the POD eigenfunctions of the flow are known over the region $0 < y \leq y_1$, where $y_1 > y_0$. Our procedure then consists in constructing an estimate for the flow field at $y^+ = y_0$, using least squares estimation to determine the POD temporal coefficients from the knowledge of the flow on the restricted domain $y_0 < y \leq y_1$. This estimate constitutes a synthetic wall boundary condition for the restricted domain.

The validity of the estimation method was studied in Podvin et al. (JFE 2010). The estimation of the temporal amplitude of a given POD mode was found to be correct as long as the spatial signature of that mode could be detected in the restricted domain. Synthetic boundary conditions were then tested for a simulation at moderate Reynolds number $R_* = 180$, for different heights $y_0 = 17$ and $y_0 = 50$. Two types of boundary conditions were considered: one was obtained by the estimation procedure described above, and therefore relied on feedback from the restricted simulation. The other was based on the integration of low-dimensional model for the amplitude of the POD modes, and was therefore completely independent of the simulation. For both types of boundary conditions turbulent statistics appear to match those of a full channel field at some distance from the boundary, on the order of y_0, although the adaptation height turned out to be smaller in the feedback case. These results are described in Podvin and Fraigneau (JOT, 2011). More recently tests have been carried out at higher Reynolds numbers $R_\tau=295$ and $R_\tau=590$ (Illustrations 9 and 10).

(a)

(b)
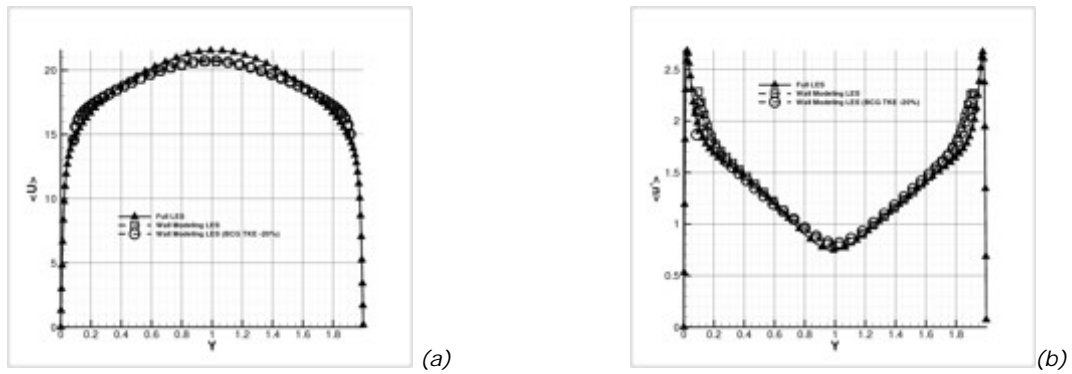
Illustration 9 –Turbulent channel flow problem: simulation in the reduced domain at R_τ=590 with the reference case; a) Mean velocity b) Reynolds stress

(a)   (b)   (c)
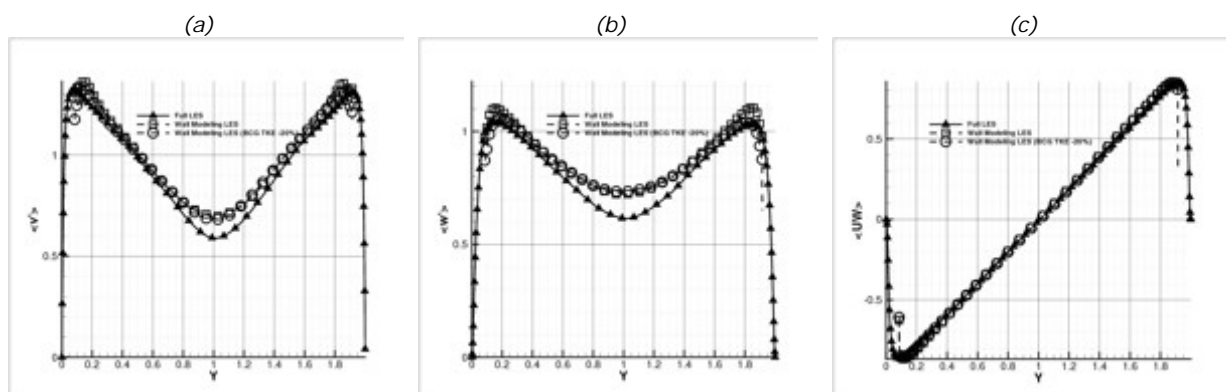
Illustration 10 – Turbulent channel flow problem: simulation in the reduced domain at R_τ=590 with the reference case; a) Streamwise r.m.s velocity b) Spanwise r.m.s velocity c) Wall-normal r.m.s velocity.

Feedback flow control *(L. Mathelin, O. Le Maitre, F. Lusseyran, L. Pastur, C. Douay)*

The main developments within the theme of control methodologies are focused on closed-loop control for fluid flows. Specifically, the idea is to approximate the mapping between the state of the priorly reduced system to the space of control command for a given control objective to be fulfilled. In practice, a class of control command is chosen and a flow quantity, say the drag or pressure fluctuations, is to be optimized (minimized or maximized, depending on the quantity chosen) over some time horizon in the future. The physical system is first described by a low number of degrees of freedom, here using Proper Orthogonal Decomposition, and the resulting mapping is approximated with Legendre polynomials. This framework allows to shift the computational burden off-line, in a pre-processing step, allowing for an efficient closed-loop, real-time compatible, control of potentially complex physical systems.

To improve the resulting control performance and widen its applicability, the multi-dimensional Legendre polynomials were substituted with a multi-resolution framework relying on wavelets. This allows accurately describing complex mapping response surfaces and hence results in superior control performance. To further improve upon the methodology, one takes advantage of the fact that a few variables are responsible for most of the approximation accuracy, i.e., most of the mapping coefficients only weakly contribute to the approximation. This calls for techniques exploiting underlying sparsity of the representation in the retained functional basis, allowing to focus the available information on the mapping, e.g. issued from direct-adjoint Navier-Stokes simulations, onto the dominant coefficients only, resulting in an off-line step requiring less information hence less CPU-involved. This work has been demonstrated for the drag reduction of the flow around a bluff body [L. Mathelin et al., 2012].

In the PhD thesis of C. Douay, we intend to apply this closed-loop control technique to the active forcing of the self-sustained open cavity flow since very few results can be found in the literature at very low Mach number. Therefore plasma actuators (DBD) have been implemented on the experimental setup, at the cavity leading edge. On the opposite of the common search for efficiency in rapid flows, our DBD tuning goal

aims at generating a very small disturbance. Preliminary results show that beyond a critical forcing amplitude, when the forcing frequency is not too far from the natural dominant frequency of the shear layer, the shear layer oscillations lock on the forcing frequency. The locking onset depends on the forcing frequency, as expected for the non-linear locking of two oscillators. At frequencies smaller than about half the natural frequency, the shear layer locks on harmonics of the forcing frequency, indicating that the shear layer transfers energy from low frequencies to higher most amplified frequencies. At frequencies larger than about twice the natural frequency, no locking is observed anymore. Deeper insights on non-linear modes coupling and design of a control loop are expected from this preliminary study.

Highlights

- Coupling space Adaptive MultiResolution with a new resolution strategy based on time operator splitting leads to a novel approach that is very competitive within a prescribed accuracy, compared to more classical approaches, in the context of very localized and stiff reaction fronts when large simulation domains are considered with conventional computing resources.
- A conservative coupling algorithm between a compressible flow and a rigid body has been developed by using an Embedded Boundary Method. Numerical examples showed that this algorithm agrees very well with body-fitted methods and improves on previous results obtained with Immersed Boundary algorithms since it is computationally efficient, it recovers second-order convergence and it is also capable of dealing with solid boundaries coming very close to each other.
- A multi-resolution framework has been proposed together with an adaptive algorithm for the control of the local stochastic resolution. The projection coefficients are computed by means of Galerkin projections, leading to the resolution of an extended system of conservation law.
- The glottal jet is a pulsating high aspect ratio jet, usually modeled as a mainly 2D flow, even if its nature is 3D. A Stereoscopic Particle Image Velocimetry setup was used to measure the 3D velocity fields of the airflow created by a self-oscillating vocal fold replica. This enabled to perform, for the first time, a three-dimensional reconstruction of the glottal jet throughout a glottal cycle. (a video of the time-varying 3D reconstruction is available online – Experiments in Fluids (2011) DOI 10.1007/s00348-011-1247-3)
- High aspect ratios jets typically present an effect called axis switching, i.e. a cross-section evolution in which the minor and major axes switch identity as the downstream distance from the jet exit increases. On the other hand, several jet types present flow regions in which they are self-similar. A similarity analysis is proposed for the time-averaged fields of a glottal-like jet in a region close to the jet exit, that takes into account its three-dimensional nature. The similarity properties are useful to predict the axis-switching phenomenon.
- Fast computing of Lagrangian Coherent Structures (LCS) in 3-D has been developed using Finite-Time Lyapunov Exponent (FTLE) calculations through GPU, SIMD algorithms and intensive parallelism. Explorations of the 3-D LCS in the open cavity flow from both experimental 2D-PIV snapshots and 3D DNS events are in progress.
- Dynamic Mode Decomposition (DMD) and Fourier modes provide a spatial characterization of Eulerian coherent structures intrinsically associated with relevant frequencies. This enlightens the non-linear coupling between the shear layer and the internal dynamics in the open cavity flow.
- A sparsity-exploiting technique has been employed to lighten the CPU burden of determining gain-scheduling-type closed-loop control laws. Combined with a wavelets-based multi-resolution approach, it has demonstrated a good performance in controlling a 2-D cylinder flow.

Staff

Permanent Staff

Firstname	Lastname	Type of position	Employer	HDR	Arrival date	Departure date
Virginie	Daru	Ass. Prof.	ENSAM			
Thierry	Faure	Ass. Prof.	UPMC	HDR		On leave at Ecole de l'Air as of 30/09/2011
Olivier	Le Maitre	DR	CNRS	HDR		
François	Lusseyran	CR	CNRS	HDR		

Lionel	Mathelin	CR	CNRS		
Luc	Pastur	Ass. Prof.	U-PSud		
Stéphanie	Pellerin	Ass. Prof.	U-PSud		
Bérengère	Podvin	CR	CNRS	HDR	
Denisse	Sciamarella	CR	CNRS		
Christian	Tenaud	DR	CNRS	HDR	

PhD Students

Firstname	Lastname	Graduate school	University	Type of support	Start date	Date of defense
Jérémy	Basley	Physique	U-PSud	CDD CNRS DGA	01/10/2008	
Christelle	Douay	SMAER	UPMC	CDD CNRS DGA	01/10/2010	
Florimond	Gueniat	MIPEGE	U-PSud	CDD CNRS DIGITEO	01/10/2010	
Laurent	Monasse	ICMS	UPEMLV	CDI ENPC	01/10/2008	10/10/2011
Joao	Pinto	SMAER	UPMC	Portugal PhD grant	01/10/2008	
Maria Adela	Puscas	MSTIC	UPEMLV	CEA PhD grant	13/10/2011	
Mohamed-Yazid	Rizi	EDSP	ENS Cachan	ENS CACHAN PhD grant	01/09/2011	
Thomas	Rouillon	SMAER	UPMC	CIFRE/CDD PSA	18/11/2009	
Julie	Tryoen	ICMS	ENPC	ENPC PhD grant	01/10/2008	21/11/2011

Non permanent staff

Firstname	Lastname	Type of position	Employer	Arrival date	Departure date
Guillermo	Artana	Visiting Professor	Univ. Buenos-Aires	09/05/2011	24/05/2011
Guillermo	Artana	Visiting Professor	Univ. Buenos-Aires	17/12/2011	16/01/2012
Ercan	Atam	Post-Doc	CNRS	01/12/2010	31/05/2012
Philippe	Debesse	Research Eng.	CNRS	01/01/2011	28/02/2013
Thierry	Faure	External Collaborator	CReA	01/10/2011	

Indicators of scientific notoriety

Editorial board appointment

- O. Le Maître is associate editor of the International Journal for Uncertainty Quantification.

Organization of international or national scientific events

Member of the scientific, technical program and/or organizational committees for international/national conferences or workshops

- O. Le Maître is the organizer of the International School on Uncertainty Quantification at Oberwolfach, Germany. One week, June 2011, 20 participants.
- O. Le Maître is the organizer of the CIMPA-Unesco School on Numerical Methods for Uncertainty Quantification, Tuhal, Saudi Arabia. One week, January 2012, 50 participants.
- O. Le Maître organized the MoMaS conference, 3 days, 60 attendees, CIRM Marseille, November 2011.
- O. Le Maître is a member of the Scientific Committee for the International Conference Uncertainty 2012, Maresias, Brazil.
- Spring Schools for Computational Fluid Dynamics (Ecoles de printemps de Mécanique des Fluides Numérique) 2011 (12th edition at Roscoff, France), organized with the support of the French-German Research Group on CFD: O. Le Maître, Coordinator and C. Tenaud, Co-Coordinator.
- F. Lusseyran is Co-Coordinator of « Les journées de Dynamique des Fluides du plateau de Saclay » 2011 at the Paris-Sud University, Orsay.
- L. Pastur is member of the Scientific Committee of "Les Rencontres du Non-Linéaire", 2010 at Ecole de Chimie, Paris, and 2011 at UPMC, Paris.
- L. Pastur is a member for 2011 of the organizing committee of the Summer School of Non-linear (Ecole d'été du Non-Linéaire) at Peyresq.
- D. Sciamarella, Inaugural colloquium of the International Associated Laboratory Physics and Fluid Mechanics (LIA PMF) ; March 8-10th 2010, Buenos Aires, Argentine
- D. Sciamarella, Opening Conference of the Virtual Net « Raíces » in Fluids of the Mincyt Program (Argentine); October 10th, 2010, Buenos Aires, Argentine

- C. Tenaud is a member of the French Scientific Committee of ICTAM 2012 (Beijing) selecting the French papers.
- C. Tenaud is member of the Scientific Committee of the 3rd Int. Conf. of Turbulence and Interactions 2012.

Invited lectures, talks or seminars

Keynote speaker at international conferences

- O. Le Maître, *Int. Conference on Mathematical Modeling in Industry*, São Paulo, Brazil, 2011.

Tutorial at workshops or conferences or summer schools

- C. Tenaud & M. Duarte, *Tutorial on Multiresolution techniques for adaptive mesh refinement*, at the Thematic School of the GDR Calcul devoted to "Méthodes multirésolution et méthodes de raffinement adaptatif de maillage", Fréjus 2010.
- F. Lusseyran, L. Pastur & C. Tenaud, *Expérience modèle et simulation fidèle, un enjeu en Mécanique des Fluides ?* Invited lecture at the workshop "Observation & Calcul" l'Atelier Sciences, Histoire et Cité (ASHiC), UPMC, Paris, 27 & 28 November 2011.

Invited talk (national or international)

- O. Le Maître, International workshop on multi-scales methods, Linz, Austria, December 2011.
- O. Le Maître, Uncertainty Quantification in Fluid Flow Models, NATO RTO-AVT-VKI lecture series, VKI, Brussels, Belgium, October 2011.
- O. Le Maître, International workshop on High dimensional aspects of stochastic PDEs, Hausdorff research Institute on Mathematics, Bonn, Germany, August 2011.
- O. Le Maître, International workshop on Computing with uncertainty, Institutes for Mathematics and its Applications, University of Minnesota, USA, October 2010.
- O. Le Maître, International workshop on Uncertainty Quantification, International Centre for Mathematical Sciences, Edinburg, Scotland, May 2010.
- O. Le Maître, workshop on Uncertainty and Stochastic PDE's, InDAM Politecnico Torino, May 2010.
- C. Tenaud, *Schéma de haute résolution couplé à de la multirésolution adaptative pour la prédiction d'écoulements visqueux compressibles*, Séminaire de mécanique des fluides des laboratoires Cassiopée et Dieudonné, Université de Nice, Nice, France, 2011.
- F. Lusseyran, *Introduction into the experimental and theoretical study of interfacial fluid flows, Marie Curie Initial Training Network Multiscale complex fluid flows and interfacial phenomena (MULTIFLOW)*, Internal summer school September 7-11 2009, Orsay, France.

Invited workshop speaker

- O. Le Maître at the International workshop on multi-scales methods, Linz, Austria, December 2011.
- O. Le Maître at the International workshop on High dimensional aspects of stochastic PDEs, Hausdorff research Institute on Mathematics, Bonn, Germany, August 2011.
- O. Le Maître at the International workshop on Computing with uncertainty, Institutes for Mathematics and its Applications, University of Minnesota, October 2011.
- O. Le Maître at the International workshop on Uncertainty Quantification, International Centre for Mathematical Sciences, Edinburg, May 2010.
- C. Tenaud at the 1st Day of GDR Calcul, IHP, Paris 2009.
- C. Tenaud at the annual workshop of the GDR Calcul, IHP, Paris 2011.

Participation in expertise and administration of research

International or national scientific networking

International networks

- We actively participate at the International Laboratory (LIA) on Physics and Fluid Mechanics (PMF), in a strengthen collaborative work with University of Buenos Aires (Argentina), Pprime Intitute at Poitiers (France) and PMMH/ESPCI, Paris (France) on dynamical analysis, manipulation, and control of unsteady fluid flows with large vortices.
- O. Le Maître is reviewer for Simulation program at DOE.

National networks or working groups

- C. Tenaud is a member of the Comité National Français de Mécanique, interface between IUTAM and the French Community of Mechanics.

- We participate to several topics into GDR and GNR: GDRE Mécanique des Fluides Numérique (C. Tenaud), GDR 2502 Contrôle des décollements (T. Faure, F. Lusseyran, L. Mathelin, L. Pastur, S. Pellerin, B. Podvin, C. Tenaud), Turbulence (F. Lusseyran, B. Podvin, C. Tenaud), GDR 2489 Dynamique et contrôle des ensembles complexes (F. Lusseyran, L. Pastur, D. Sciamarella), GNR MoMaS (O. Le Maître, L. Mathelin).
- O. Le Maître is the Deputy Director of GNR MoMaS (Modélisations Mathématiques et Simulations numériques liées au problème de stockage des déchets nucléaires) (2010-2012), Deputy Director of GdR MoMaS (INSMI, since 2011).

Participation in evaluation or expertise committees

National committees (CoNRS, CNU, CCSU…)

- V. Daru is member of the 60th section of the CNU since 2011
- F. Lusseyran is member of the CCSU 60th, 61th, and 62th sections of the Paris-Sud University (since 2011) and of selection committee (CDS) in 2009 at the Ecole Centrale de Lyon and the Toulouse University, and in 2009, 2010, and 2012 at the Orléans University.
- L. Pastur is member of CCSU 60th section, in 2009 CDS INPL-Nancy and in 2011 at Ecole Centrale de Lille.

Expert for scientific evaluation committees

- T. Faure acts as Scientifique Expert for Fonds Québécois de la Recherche sur la Nature et les Technologies (2010) - programme établissement de nouveaux chercheurs 2011-2012

Member of selection juries

- We participated in several CCSE for different Schools or Universities: Univ. Paris-Sud, UPMC, ENSAM, CNAM, Rouen University, Paris-East Marne-La-Vallée University, INPL Nancy, Ecole centrale Lille.
- C. Tenaud is a member of the Conseil de l'École Doctorale SMAER (ED 491) of UPMC
- O. Le Maître is scientific consultant at the CEA/DEN/DM2S.

Teaching activities and duties in relation to research

- Four Associate Professors belong to the group: V. Daru (MdC, Arts & Métiers, ParisTech), T. Faure (MdC, UPMC, Paris), L. Pastur and S. Pellerin (MdC, Paris-Sud, Orsay).
- T. Faure is responsible of the Tutorial platform of Fluid Mechanics, UPMC, Paris
- Professors teach in several Masters: Sciences de l'Ingénieur of UPMC, Paris (B. Podvin), Dynamique des Fluides et des Transferts, co-habilité UPMC and Paris-Sud (F. Lusseyran), Mécanique énergétique de l'Université de Nancy, Fluides Atmosphères et Plasmas de l'Université d'Orléans (F. Lusseyran), ainsi qu'aux enseignements en Calcul Scientifique de l'ENPC (O. Le Maître)

Dissemination and vulgarization

- We participate at the « Fête de la sciences » days in 2010 and 2011 at the Paris-Sud University.
- D. Sciamarella. Press articles in Journal Página/12:
  http://www.pagina12.com.ar/diario/suplementos/futuro/13-2272-2010-01-02.html
  http://www.pagina12.com.ar/diario/suplementos/futuro/13-2576-2011-08-13.html
  http://www.pagina12.com.ar/diario/suplementos/futuro/13-2440-2010-11-06.html
- D. Sciamarella. Interview for Radio UBA.
- D. Sciamrella. Communication Video. Ciclo de Videoentrevistas, Facultad de Ingeniería de la UBA.

Research conventions and contracts

Valorization

Two simulation platforms (softwares), based on the development of high resolution schemes (OSMPx schemes), subgrid modelling, and Multiresolution techniques, were written to perform highly accurate simulations of compressible unsteady flows. These codes have started to disseminate in the CFD community.

- CHORUS (High-Order Compressible Unsteady Simulation): a license has been filed DI 03055-1;
- MR_CHORUS (MultiResolution_CHORUS): a license has been filed DI 03760-01

Valorization project & Invention statement (transmitted to the *Direction de l'Innovation et Relations avec les Entreprises du CNRS*): Système de pulsation d'écoulement d'air pour contrôle aérodynamique. Artana-Sciamarella

Industrial relationships

Although researches conducted in the group are relatively fundamental, activities are also linked to applications with a real desire for recovery. We work in collaboration, through contracts, with:

- Agencies: ANDRA, BRGM, DEN/CEA, DAM/CEA, IRSN, ONERA;
- Industrial partners: Dantec Dynamics, EDF, PSA (PCA), Renault (RCA).

Contract table

Acronym	Funding agency/Partner	Program	Nature	Resp. for LIMSI	General coordinator	Starting date	Ending date	LIMSI share
HiSpeed PIV	ANR	Basic Science	Research collab.	Pastur L.	Moisy F. (FAST)	08/11/2006	07/05/2010	122400
DIB 2007	ANR	Basic Science	Research collab.	Lusseyran F.	Borée J. (PPRIME)	01/12/2007	30/11/2011	150000
MoMaS	CNRS	Programme interdisciplinaire PACEN	Research support	Le Maitre O.	Le Maitre O.	01/01/2008	31/12/2011	47432
	CEA-ENPC	PhD supervision	Research collab.	Daru V.	Daru V.	01/10/2008	30/09/2011	
	ENPC	PhD supervision	Research collab.	Le Maitre O.	Le Maitre O.	01/10/2008	30/09/2011	
ASRMEI	ANR	JCJC	Research collab.	Le Maitre O.	Le Maitre O.	01/01/2009	31/12/2011	114407
CORMORED	ANR	Basic Science	Research collab.	Mathelin L.	Mathelin L.	01/01/2009	31/12/2012	127000
	PCA	CIFRE	Research collab.	Tenaud Ch.	Tenaud Ch.	16/11/2009	15/11/2012	25000
LIA	CNRS		Research collab.	Sciamarella D.		01/01/2010		5850
CNRS/ASB	CNRS – Acad. des sciences Bulgare		Partnership	Daru V.	Daru V.	17/02/2010	31/12/2011	2000
FLUCTUS	Digiteo	Projet Emergent	Research collab.	Pastur L.	Pastur L.	01/09/2010	31/08/2013	111288
MUSE	Digiteo	Projet Emergent	Research collab.	Tenaud Ch.	Massot M. (EM2C)	01/10/2010	30/09/2013	83500
TYCHE	ANR	Basic Science	Research collab.	Le Maitre O.	Le Maitre O.	01/12/2010	30/11/2013	65936
COPERSFI	Digiteo	PhD grant	Research collab.	Mathelin L.	Mathelin L.	01/09/2011	31/10/2014	
CALIFHA	Digiteo	PhD grant	Research collab.	Le Maitre O.	Baboulin M. (LRI)	01/10/2011	30/09/2014	
TUYERES	Université d'Evry		Research collab.	Tenaud Ch.	Tenaud Ch.	29/11/2011	28/11/2013	
	EADS	PhD grant	Research collab.	Duguet Y.	Duguet Y.	15/12/2011	31/12/2015	132000

Scientific Publications

Doctoral theses and HDR

T1. Monasse, L., *Analysis of a discrete element method and coupling with a compressible fluid flow method* 2011, thèse de l'ENPC, Université Paris-Est. Soutenue à Marne-la-Vallée, France, le 10 octobre 2011, 170 p.

T2. Tryoen, J., *Méthodes de Galerkin stochastiques adaptatives pour la propagation d'incertitudes paramétriques dans les systèmes hyperboliques* 2011, thèse de l'ENPC, Université Paris-Est. Soutenue à Marne-la-Vallée, France, le 21 novembre 2011, 161 p.

Articles in peer reviewed scientific journals

A1. Basley, J., L. Pastur, F. Lusseyran, T. Faure, and N. Delprat, *Experimental investigation of global modes in an incompressible cavity flow using time-resolved PIV. Experiments in Fluids*, 2011. **50** (4): pp.905-918.

A2. Chisari, N., G. Artana, and D. Sciamarella, *Vortex dipolar structures in a rigid model of the larynx at flow onset. Experiments in Fluids*, 2011. **50**: pp.397-406.

A3.   Daru, V., P. Le Quéré, M.-C. Duluc, and O. Le Maitre, *A numerical method for the simulation of low Mach number liquid-gas flows. Journal of Computational Physics*, 2010. **229** (23): pp.8844-8867.

A4.   Duarte, M., M. Massot, S. Descombes, C. Tenaud, T. Dumont, V. Louvet, and F. Laurent, *New resolution strategy for multi-scale reaction waves using time operator splitting and space adaptive multiresolution: application to human ischemic stroke*. ESAIM Proceedings, 2011. **34**: pp.277-290.

A5.   Duarte, M., M. Massot, F. Laurent, S. Descombes, C. Tenaud, T. Dumont, and V. Louvet, *New Resolution Strategies for Multi-scale Reaction Waves: Optimal Time Operator Splitting and Space Adaptive Multiresolution*. CLEI Electronic Journal (Latin-american Center for Informatics Studies), 2011. 14 (1): pp.1-14.

A6.   Duguet, Y., O. Le Maitre, and P. Schlatter, *Stochastic and deterministic motion of a laminar-turbulent front in a spanwisely extended Couette flow*. Physical Review E, 2011. **84**: pp.066315_1-066315_14.

A7.   Krebs, F., F. Silva, D. Sciamarella, and G. Artana, A Three-dimensional study of the glottal jet. Experiments in Fluids, 2011. pp.1-15.

A8.   Le Maitre, O. and L. Mathelin, *Equation free model reduction for complex dynamical systems*. International Journal for Numerical Methods in Fluids, 2010. **63** (2): pp.163-184.

A9.   Le Maitre, O. and L. Mathelin, *Asynchronous time integration for polynomial chaos expansion of uncertain periodic dynamics*. Discrete and Continuous Dynamical Systems, 2010. **28** (1): pp.199-226.

A10.   Mathelin, L., C. Desceliers, and M. Hussaini, *Stochastic data assimilation with a polynomial chaos parametric estimation*. Computational Mechanics, 2011. **47** (6): pp.603-616.

A11.   Mathelin, L. and O. Le Maitre, *Uncertainty quantification in a chemical system using error estimate-based mesh adaption*. Theoretical and Computational Fluid Dynamics, 2010. pp.1-20.

A12.   Mathelin, L., L. Pastur, and H. Abou-Kandil, *Closed-loop fluid flow control using a low dimensional model*. Mathematical and Computer Modelling, 2010. **52** (7-8): pp.1161-1168.

A13.   Podvin, B. and Y. Fraigneau, *Synthetic wall boundary conditions for the direct numerical simulation of wall-bounded turbulence*. Journal of Turbulence, 2011. **12** (4): pp.1-26.

A14.   Podvin, B., Y. Fraigneau, J. Laval, and J. Jouanguy, *On self-similarity in the inner wall layer of a turbulent channel flow*. Journal of Fluids Engineering, 2010. **132** (4): pp.041202_1-041202_15.

A15.   Sargsyan, K., B. Debusschere, H. Najm, and O. Le Maitre, *Spectral representation and reduced order modeling of the dynamics of stochastic reaction networks via adaptive data partitioning*. SIAM Journal on Scientific Computing, 2010. **31** (6): pp.4395-4421.

A16.   Tenaud, C. and M. Duarte, *Tutorials on Adaptive multiresolution for mesh refinement applied to fluid dynamics and reactive media problems*. ESAIM Proceedings, 2011. **34**: pp.184-239.

A17.   Tryoen, J., O. Le Maitre, M. Ndjinga, and A. Ern, *Intrusive Galerkin methods with upwinding for uncertain nonlinear hyperbolic systems*. Journal of Computational Physics, 2010. **229** (18): pp.6485-6511.

A18.   Tryoen, J., O. Le Maitre, M. Ndjinga, and A. Ern, *Roe solver with entropy corrector for uncertain hyperbolic systems*. Journal of Computational and Applied Mathematics, 2010. **235** (2): pp.491-506.

Books and chapters in books

B1.   Duarte, M., M. Massot, S. Descombes, C. Tenaud, and S. Candel, *Time-space adaptive numerical methods for the simulation of combustion fronts, in Center for Turbulence Research*, Annual Research Briefs, P. Moin and J.E. Larson, Eds. 2011. pp. 347-358.

B2.   Le Maitre, O. and O. Knio, Spectral methods for uncertainty quantification (with applications to computational fluid dynamics) 2010: Springer. 552p.

B3.   Noury, S., S. Boivin, and O. Le Maitre, *A Fast Poisson Solver for OpenCL using Multigrid Methods, in GPU Pro 2: Advanced Rendering Techniques*, E. W. Engel, Editor. 2011. pp. 445-471.

Conferences with proceedings and review committee

C1.   Abbas-Turki, M., H. Abou-Kandil, L. Mathelin, and L. Pastur. *A robust control strategy for drag reduction in fluid mechanics*. in Pan-American Congress of Applied Mechanics. 2010. Foz do Iguacu, Brazil. 6p.

C2.   Amroune, A., C. Letellier, and L. Pastur. *Dynamiques toroidales non triviales dans un laser spatio-temporel*. in Rencontre du Non-Linéaire. 2010. Paris, France. 7-12.

C3.   Amroune, A., L. Pastur, and C. Letellier. *Des dynamiques temporelles aux diagrammes spatio-temporels: défauts, cohérence de phase et observabilité*. in Rencontre du Non-Linéaire. 2011. Paris, France. 1-6.

C4.   Daru, V., D. Baltean, G. Gandikota, and C. Weisman. *Etude numérique du vent acoustique non linéaire dans un résonateur à ondes stationnaires*. in Congrès Français de Mécanique. 2011. Besançon, France. 1190_1-1190_6.

C5.   Douay, C., T. Faure, and F. Lusseyran. *Caractérisation multi-plan d'un écoulement de cavité tridimensionnel par PIV stéréoscopique*. in Congrès Français de Mécanique. 2011. Besançon, France. 6p.

C6.   Douay, C., F. Gueniat, L. Pastur, F. Lusseyran, and T. Faure. *Instabilités centrifuges dans un écoulement de cavité : décomposition en modes dynamiques*. in Rencontre du Non-Linéaire. 2011. Paris, France. 47-52.

C7.   Faure, T., C. Douay, S. Mochki, F. Lusseyran, and G. Quénot. *Stereoscopic PIV using optical flow: investigation of a recirculating cavity flow*. in International ERCOFTAC Symposium on Engineering Turbulence Modelling and Measurements. 2010. Marseille, France. 905-910.

C8.   Faure, T., C. Douay, S. Mochki, F. Lusseyran, and G. Quénot. *PIV stéréoscopique par flot optique*. in Congrès Francophone de Techniques Laser. 2010. Nancy, France. 443-450.

C9.   Faure, T., H. Thach, J. Basley, L. Pastur, and F. Lusseyran. *Moyenne de phase spatiale appliquée à des champs PIV résolus en temps*. in Congrès Francophone de Techniques Laser. 2010. Nancy, France. 111-118.

C10.   Gueniat, F., J. Basley, C. Douay, L. Pastur, F. Lusseyran, T. Faure, and P. Schmid. *Flow coherent structures and frequential signature: application of the dynamic modes decomposition to open cavity flow*. in EUROMECH European Turbulence Conference. 2011. Warsaw, Poland: IOP. 042036_1-042036_8.

C11.   Gueniat, F., C. Douay, F. Lusseyran, L. Pastur, and T. Faure. *Signature fréquentielle des structures cohérentes - Décomposition en Modes Dynamiques ; application à un écoulement en cavité ouverte*. in Congrès Français de Mécanique. 2011. Besançon, France. 1-6.

C12.   Gueniat, F., L. Pastur, F. Lusseyran, and T. Faure. *Opérateur de Koopman et identification de structures cohérentes: application à un écoulement de cavité*. in Rencontre du Non-Linéaire. 2011. Paris, France. 87-92.

C13.   Krebs, F., G. Artana, and D. Sciamarella. *Glottal aperture modes and acoustic output in an in-vitro self-oscillating vocal-fold model*. in Congrès Français d'Acoustique. 2010. Lyon, France. 1-4.

C14.   Malet, J., T. Gelain, O. Desgrées du Lou, and V. Daru. *Evaporation over sump surface in containment studies: code validation on TOSQAN tests*. in International Topical Meeting on Nuclear Reactor Thermalhydraulics. 2011. Toronto, Canada. 1-6.

C15.   Monasse, L., V. Daru, C. Mariotti, and S. Piperno. *A conservative coupling method for fluid-structure interaction in the compressible case*. in International Conference on Computational Fluid Dynamics. 2010. Saint Petersburg, Russia. 6p.

C16.   Monasse, L., V. Daru, C. Mariotti, S. Piperno, and C. Tenaud. *Un algorithme de couplage conservatif pour l'interaction fluide-structure dans le cas compressible*. in Congrès Français de Mécanique. 2011. Besançon, France. 100_1-100_6.

C17.   Pastur, L., F. Lusseyran, T. Faure, and C. Letellier. *Mode-competition in flow-oscillations investigated by means of symbolic dynamics. in International* Conference on Chaotic Modeling, Simulation and Applications. 2011. Agios Nikolaos, Crete Greece. 415-422.

C18.   Pinto, J., Y. Fraigneau, L. Oliveira, and C. Tenaud. *Numerical simulation of a two-phase flow in an oil filter by coupling a LES approach with a Lagrangian particle tracking*. in European Conference on Computational Fluid Dynamics. 2010. Lisbon, Portugal. 17p.

C19.   Podvin, B. and P. Le Quéré. *Etude d'un canal stratifié différentiellement chauffé*. in Rencontre du Non-Linéaire. 2011. Paris, France. 133-138.

C20.   Rouillon, T., F. Harambat, L. Mathelin, and C. Tenaud. *Global optimization of vortex generator parameters for drag reduction of ground vehicles*. in CFD & OPTIMIZATION, An ECCOMAS Thematic Conference. 2011. Antalaya, Turkey. 075_1-075_17.

C21.   Rouillon, T., F. Harambat, C. Tenaud, L. Mathelin, and A. Queuille. *Modélisation par termes source de générateurs de vortex pour le contrôle d'écoulement: validations expérimentales et optimisations*. in Congrès Français de Mécanique. 2011. Besançon, France. 107_1-107_6.

C22.   Sciamarella, D., F. Krebs, and G. Artana. *Tracking vortex dipolar structures in a laryngeal-like jet. in Argentinian* Congress on Computational Mechanics. 2010. Buenos Aires, Argentina: Asociacion Argentina de Mecánica Computacional. 3883-3889.

C23.   Sergent, A., Z. Gao, B. Podvin, S. Xin, and P. Le Quéré. *Simulation de l'écoulement dans un canal différentiellement chauffé*. in Congrès Français de Mécanique. 2011. Besançon, France. 286_1-286_6.

C24.   Tenaud, C. *An adaptive multiresolution technique for unsteady compressible flow simulations*. in Symposium on Applied Aerodynamics. 2010. Marseille, France. 10p.

C25.   Tenaud, C., Y. Fraigneau, and V. Daru. *Numerical simulation of the turbulent detached flow around a thick flat plate*. in International Conference on Computational Fluid Dynamics. 2010. Saint Petersburg, Russia. 6p.

C26.   Tenaud, C., Y. Fraigneau, and V. Daru. *Simulation numérique du décollement et recollement turbulent autour d'une plaque plane épaisse*. in Congrès Français de Mécanique. 2011. Besançon, France. 180_1-180_6.

C27.   Tenaud, C., Y. Fraigneau, and V. Daru. *Numerical simulation of the turbulent separation reattachment flow around a thick flat plate*. in EUROMECH European Turbulence Conference. 2011. Warsaw, Poland: IOP. 042059_1-042059_10.

C28. Tryoen, J., O. Le Maitre, and A. Ern. *Adaptive anisotropic stochastic discretization schemes for uncertain conservation laws*. in Joint US-European Fluids Engineering Summer Meeting and 8th International Conference on Nanochannels, Microchannels, and Minichannels. 2010. Montreal, Canada. 16p.

C29. Tryoen, J., O. Le Maitre, M. Ndinga, and A. Ern. *Roe solver and entropy corrector for hyperbolic systems with uncertain coefficients*. in European Conference on Computational Mechanics. 2010. Paris, France.

Conferences without proceedings, workshops

D1. Alizard, F., J. Basley, J. Robinet, T. Faure, L. Pastur, X. Gloerfelt, F. Lusseyran, and N. Delprat. *Flow dynamics in open square cavity: experimental and stability comparisons*. in European Fluid Mechanics Conference. 2010. Bad Reichenhall, Germany: Euromech.

D2. Amroune, A., L. Pastur, and C. Letellier. *A link between defects in spatiotemporal diagrams and observability*. in From Laser Dynamics to Topology of Chaos. 2011: CORIA Université de Rouen.

D3. Delprat, N., J. Basley, L. Pastur, F. Lusseyran, and T. Faure. *Investigation of the different amplitude modulated regimes observed in an experimental incompressible cavity flow*. in European Fluid Mechanics Conference. 2010. Bad Reichenhall, Germany.

D4. Duguet, Y., O. Le Maitre, and P. Schlatter. *Front velocities in plane Couette flow*. in Annual Meeting of the APS Division of Fluid Dynamics. 2011. Baltimore, USA.

D5. Gueniat, F., C. Douay, L. Pastur, F. Lusseyran, M. Ammi, J. Falcou, and R. Montagne. *Fast FTLE computations ; Computations of Lagrangian Coherent Structures*. in International Symposium Bifurcations and Instabilities in Fluid Dynamics. 2011. 18/07 au 21/07. 00-00.

D6. Knio, O., O. Le Maitre, L. Mathelin, and M. Hussaini. *Asynchronous time integration for periodic dynamical systems with uncertain parameters*. in AN10. 2010 SIAM Annual Meeting. 2010.

D7. Le Maitre, O. *Spectral methods for uncertainty quantification in fluid flow models*. in INdAM Workshop on Uncertainty Quantification. 2010.

D8. Le Maitre, O. *Adaptive and non-tensored stochastic discretizations for stochastic systems*. in Workshop on Uncertainty Quantification for Multiscale Systems. 2010.

D9. Le Maitre, O., L. Mathelin, O. Knio, and M. Hussaini. *Asynchronous time integration for polynomial chaos expansion of uncertain periodic dynamics*. in European Conference on Computational Mechanics. 2010. Paris, France.

D10. Le Maitre, O., J. Tryoen, and A. Ern. *Adaptive strategies for uncertain hyperbolic systems*. in SIAM Annual Meeting. 2010. Pitsburgh, USA.

D11. Le Maitre, O., J. Tryoen, and A. Ern. *Multiresolution for stochastic hyperbolic systems*. in Uncertainty Quantification workshop organized by the International Center for Mathematical Sciences. 2010.

D12. Lusseyran, F., L. Pastur, and C. Tenaud. *Expérience modèle et simulation fidèle, un enjeu en Mécanique des Fluides ?* in Colloque de l'Atelier Sciences-Histoire-Cité (ASHiC). 2011: UPMC.

D13. Massot, M., M. Duarte, S. Descombes, C. Tenaud, T. Dumont, V. Louvet, F. Laurent, and S. Candel. *Adaptive time-space numerical methods for the simulation of multi-scale combustion fronts*. in International Conference on Numerical Combustion. 2011. Corfu, Greece.

D14. Mathelin, L., F. Bataille, and Y. Zhou. A Two-Scale *Direct-Interaction Approximation study of some compressibility effects in turbulent flow*. in AIAA Theoretical Fluid Mechanics Conference. 2011. Honolulu, USA.

D15. Mathelin, L. and K. Gallivan. *Uncertainty quantification for sparse solution of random PDEs*. in AN10. 2010 SIAM Annual Meeting. 2010.

D16. Mathelin, L., L. Pastur, and O. Le Maitre. *An adaptive compressed-sensing equation-free approach for closed-loop nonlinear control*. in AIAA Theoretical Fluid Mechanics Conference. 2011. Honolulu, USA.

D17. Monasse, L., V. Daru, C. Mariotti, and S. Piperno. *Conservative coupling of an immersed boundary method with a discrete element method for fluid-structure interaction*. in European Conference on Computational Mechanics. 2010. Paris, France.

D18. Monasse, L., V. Daru, C. Mariotti, and S. Piperno. *A conservative Immersed Boundary Method for the interaction of compressible inviscid flows with elastic structures*. in World Congress on Computational Mechanics. 2010. Sidney, Australia.

D19. Noury, S., S. Boivin, and O. Le Maitre. *Toward real-time fluid simulation for virtual reality*. in First EuroVR-EVE SIG Meeting. 2010: EuroVR. 4p.

D20. Pastur, L., F. Lusseyran, N. Delprat, T. Faure, J. Basley, and F. Gueniat. *Reduction of flow complexity within a few dynamical modes: the case of an open-cavity air-flow*. in ECC11. 11th Experimental Chaos and Complexity Conference. 2010: Université de Lille. 2p.

D21. Podvin, B. and P. Le Quéré. *Convection between two differentially heated vertical plates with stratification*. in International Symposium Bifurcations and Instabilities in Fluid Dynamics. 2011. Barcelona, Spain.

D22. Robinet, J., F. Alizard, J. Basley, T. Faure, X. Gloerfelt, L. Pastur, F. Lusseyran, and N. Delprat. *Dynamics*

in open square cavity: from linear instability to saturated regime. in European Fluid Mechanics Conference. 2010. Bad Reichenhall, Germany.

D23. Rouillon, T., F. Harambat, C. Tenaud, and L. Mathelin. *Global optimization with Gaussian process and application to drag reduction with vortex generators.* in World Congress on Global Optimization in Engineering & Science. 2011. Chania, Greece.

D24. Sciamarella, D. *Self-similarity in elongated pulsating jets with lateral confinement.* in Reunión Conjunta SUF - AFA. 2011. Montevideo, Uruguay.

D25. Silva, F., G. Artana, and D. Sciamarella. *Estudio de Turbulencia 2D con técnicas Schlieren e Interferometria.* in Reunion sobre Recientes Avances en Fisica de Fluidos y sus Aplicaciones. 2010. Colonia, Uruguay.

CAROLINE NORE

Introduction

The CORO group investigates various internal or external fluid flows using numerical methods. Historically the group has focused on flows driven by convection and/or rotation. Today our topics cover a broad range of hydrodynamic phenomena, the main focus being flow instability and the associated path to turbulence. Instability sources include buoyancy, Lorentz force, wall friction, surface tension, etc.

Thermal convection is important both for industrial or environmental applications and from a fundamental point of view. Applications include thermal engineering for construction, cooling, crystal growth, drying of thin films, thermoacoustic engines and refrigerators. Strong convection flows are turbulent and require the use of Large Eddy Simulation models. These models have been validated against Direct Numerical Simulations. On the fundamental side, we investigate the influence of the coupling between Boussinesq convection and other effects: thermal radiation, wall shear, capillary forces, evaporation.

Another strong component of the research in CORO deals with flows driven by rotation and/or shear. Vortices are found throughout in the wake of rotating devices such as propellers, wind-turbines and helicopter rotors and they affect their stability; the study of the three-dimensional instabilities of helical vortices is a prerequisite for a control strategy. Abrupt transition to turbulence in near-wall flows strongly affects the viscous drag and energetic performances in the context of aeronautics and oil transport. This phenomenon is investigated numerically in the Blasius boundary layer, Plane Couette flow and cylindrical pipe flow. Numerical prediction of bifurcations in rotating cylindrical cavities is another long-standing activity within CORO. During the last years, this topic has been extended to free surface flows, as well as to electrically conducting fluids. Dynamo action, namely the conversion of kinetic energy in magnetic energy, has been numerically demonstrated in wave-like flows and in different configurations enclosed in finite containers: rotating disks, precession, and rotation of the walls.

In parallel to physical understanding, the group is also actively involved in the development of cutting-edge numerical tools. The various numerical codes available are based on the following methods: spectral, finite differences, finite volumes and finite elements, adapted to the sometimes complex geometries under study. The treatment of the boundary conditions is a difficult challenge in open geometries or in confined geometries in the presence of a magnetic field. New methods under development include the design of low-order reduced models and tracking of passive tracers.

Research presentation

Topic 1: Buoyant convection

A. Sergent, *P. Le Quéré, J. Chergui, Y. Fraigneau, L. Martin Witkowski, B. Podvin*

We study three fundamental models of natural convection flows: Rayleigh-Bénard convection, differentially heated convection and buoyant jet in a confined cavity. Instabilities are investigated at low values of the parameters and new bifurcation scenarios emerge when other forcing terms such as rotation and radiation are added. High values of the parameters require the use of accurate numerical methods and turbulent models as well as lengthy numerical integration. In the study of thermoacoustic instabilities, a multiscale analysis shows the need for a low Mach number approach.

Natural convection coupled with rotation

Rayleigh-Bénard convection flows in a cylindrical geometry have been extensively studied. However, new instability patterns are regularly found and provide a complex and well documented collection of bifurcation scenarios. In this study, Rayleigh-Bénard convection is coupled with another source of motion, with imposed rotation of the top and bottom disks at equal and opposite angular velocities (collab. L. Martin Witkowski at LIMSI, L. S. Tuckerman at ESPCI, D. Barkley at Univ of Warwick ,UK, M C Navarro at UCLM, Spain, L. Bordja at Univ of Jilel Algeria and R. Bessaih at Univ of Constantine Algeria).

The figure on the right represents different regimes in the space parameter [Reynolds (defined by angular velocity of the disks), Rayleigh]. It shows the presence of bifurcations of the following types: Takens Bogdanov codimension-two point (TB) and SNIPER (saddle-node infinite-period), leading to complex flow dynamics. The phase portraits from (a) to (f) illustrate this dynamic. Transition to unsteady flow can occur via a Hopf bifurcation (H) from (b) to (f), or via a Sniper bifurcation (SN) from (e) to (f) or even via a global bifurcation (not detailed here) close to the Takens Bogdanov point. The Pitchfork bifurcations (PF1 then PF2) generate two pairs of stationary states (one stable and the other unstable) that lead to the limit cycle (f).
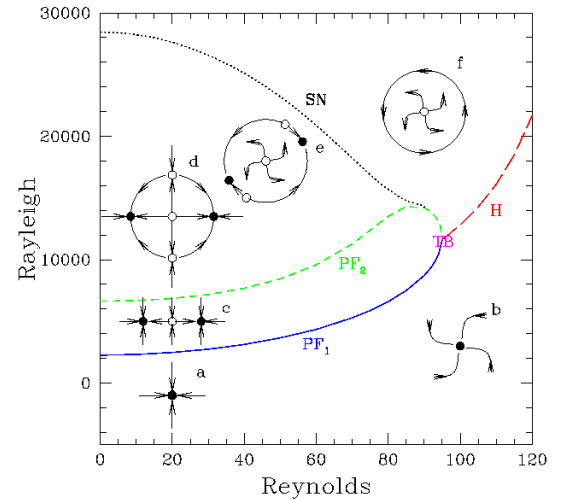
Bifurcation diagrams and phase portraits
(Prandtl=1, height =radius).

Turbulent thermal convection

Turbulent Rayleigh-Bénard convection has been computed by means of a Large Eddy Simulation in an air-filled rectangular cell of large aspect ratio for Rayleigh numbers between 10^7 and 10^{10}. For all Ra, starting from noise, a primary large scale circulation (LSC) state with four rolls fills the cavity (see right figure). This state is metastable on a very long time period and undergoes a sudden transition without any external input towards a secondary LSC. During the transition, a sharp reorientation of the rolls' axis leads to the flow reorientation. The spontaneously selected size of the circulation cells increases with Ra ranging between 10^7 to 6.10^9. However, at Ra $= 10^{10}$, the transition is more uncertain and the secondary LSC corresponds to a 3-rolls structure, whereas a 2-roll-secondary LSC is observed for Ra $= 6.10^9$. Due to the long time period over which the LSC can persist (more than 10^4 convective time units), it is unclear whether the obtained secondary LSC is stable, or if the flow will converge eventually towards a new LSC.
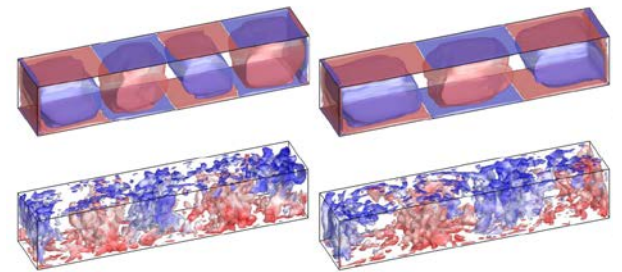
Large scale circulation structures at Ra = 6.10^8:
primary LSC (left) and secondary LSC (right)
shown by time-averaged iso-surfaces of transverse
vorticity $\Omega_y = \pm 0.3$ (top), and the relative iso-surfaces of instantaneous vertical heat flux
(~2Nu), colored by the temperature field (bottom).

Natural convection between two infinite differentially heated vertical plates

The onset of chaos in the flow between two infinite, differentially heated vertical plates as the Rayleigh number is increased is numerically studied (Ph.D thesis of Z. Gao) using a DNS code developed at LIMSI. Two cases are investigated. In the isothermal case, the temperature is constant and uniform over each plate. The base flow first bifurcates to a steady 2D rolls flow through a supercritical pitchfork bifurcation, then to steady 3D patterns, followed by oscillatory 3D structures. Chaos eventually occurs through a sequence of period-doubling bifurcations. In the stratified case, the prescribed temperature increases linearly with height along each plate. The first instability occurs through a supercritical Hopf bifurcation, corresponding to two 2D counterpropagating travelling waves – one rising along the hot plate, and the other descending down the cold one. The waves then become unstable, and give way to 2D isolated waves. These isolated waves then break down into spatially-temporal chaotic patterns through a transverse instability. Analytical Ginzburg-Landau equations were derived in both cases and were found to match the characteristics of the DNS solution around the first bifurcation (collab. B. Podvin, P. Le Quéré and A. Sergent with S. Xin at CETHIL and L. Tuckerman at PMMH)
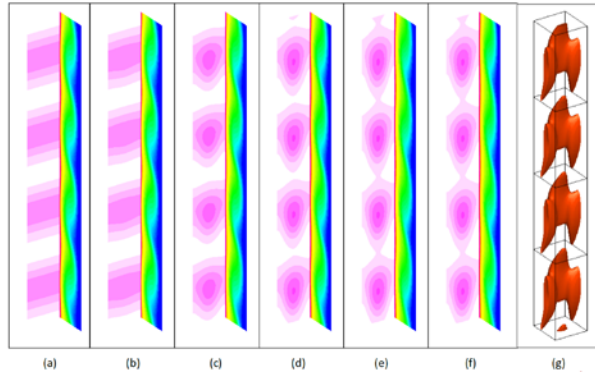
Time evolution of the flow at Ra=1.1 10^4 in the isothermal case towards a steady state. (a)-(f): temperature iso-contours at t=500 (a), t=1040 (b), t=1090 (c), t=1120 (d), t=1170 (e), t=2000 (f); (g) iso-surface of transverse vorticity of the steady state Ω$_y$=3.2.

Natural convection coupled with radiation

The well-documented discrepancy regarding the value of thermal stratification between numerical and experimental results in air-filled differentially heated cavities at high Rayleigh numbers has motivated a joint research program to integrate both wall and medium radiation in the physical model of natural convection. This project, called COCORACOPHA2 for « Couplage Convection-Rayonnement Pour l'Habitat 2 », is supported by a « Action Incitative » from the CNRS Energie program. It brings together five research teams from CETHIL (Lyon), LEPTAB (Univ. La Rochelle), PPRIME (ENSMA, Poitiers), MSME (UPEMLV), and LIMSI-CNRS. In order to resolve the stratification paradox, we have first established reference solutions by means of three-dimensional (3D) spectral direct numerical simulations of a buoyancy-driven flow (RaH=1.5×109) for two configurations: an idealized cavity (perfectly adiabatic cavity, PAC) and an Intermediate Realistic Cavity (IRC) making use of experimentally measured temperature distributions (Salat, 2004) on the top and bottom walls. Using a LES approach, it has then been proven that the complete set of experimental temperature distribution at the wall (Full Realistic Cavity) is needed to recover full agreement between numerical and experimental results. In particular, thermal boundary conditions on the front and rear walls are found to be the key ingredient to obtain a good agreement. Finally a 3D numerical code coupling convection, conduction and wall radiation has been developed, and is capable of reproducing the experimental temperature distribution inside the cavity.
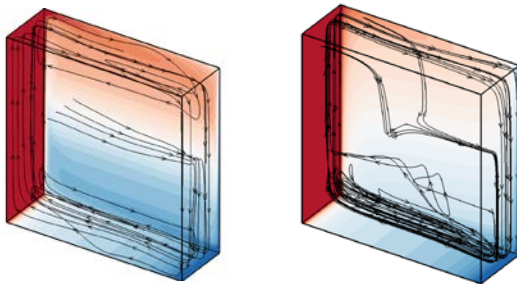
Thermal boundary conditions influence on the flow structure in an air-filled differentially heated cavity at Ra=1.5 10^9. Streamlines in the time-averaged flow. Left: IRC (Intermediate Realistic Cavity with adiabatic front and rear walls), right: FRC (Full Realistic Cavity with full experimental temperature distributions at wall).

Buoyant jet with mass gradient

The knowledge of the dispersion and mixing mechanisms at low Mach number of hydrogen in confined air-filled cavities is an important safety issue for nuclear engineering applications, as well as for all hydrogen-based systems, since fire or explosion may result from a specific concentration distribution. Due to the complexity of performing measurements with hydrogen, most of the experimental studies of the buoyant jet resulting from hydrogen leakage in air are done with helium as light gas, which has similar physical properties to hydrogen except for the molar mass M (M_Air/M_He=7.5). A buoyant jet is produced by the injection of a light gas (helium) in a quiescent heavy gas (air) at the bottom of a cavity with small openings (and consequently at constant pressure). The coexistence within the cavity of pure helium and pure air regions causes significant variations of the fluid properties (non-Boussinesq effects) and at the same time numerical convergence difficulties arise. A 2D unsteady laminar numerical model is developed (Ph.D thesis of H.L. Tran) which integrates the conservation equations of the mixture and helium mass and the mixture momentum equation. The main difficulty lies in the mixture density field determination, which should respect the mixture mass conservation together with the state law of the mixture, considered as an ideal gas. The model has been validated by comparison with experimental results of laminar starting plumes of

glycerol-water solution. (collab. P. Le Quéré and A. Sergent with G. Bernard-Michel at CEA).
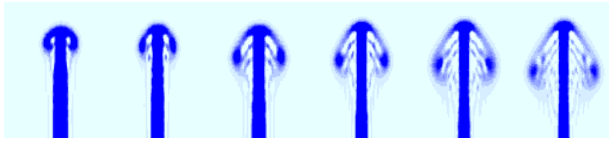
Laminar plume of glycerol-water binary mixture: time evolution of a confined head (Re=37, Gr=2.75x10⁶).

Thermal convection and thermoacoustics

Standing wave thermoacoustic engines are analyzed (collab. C. Weisman, D. Baltean-Carlès, P. Le Quéré, O. Hireche, L. Ma at LIMSI and L. Bauwens, University of Calgary) by appropriate coupling of a numerical solution for the two-dimensional Low Mach equations in the active cell and an analytical solution of linear acoustics in the resonators.

Topic 2: Free surface flows

C. Dang Vu- Delcarte, C.T. Pham, *L. Martin Witkowski*

Thermal or/and mass gradients on the free surface of a fluid give rise to inhomogeneity of surface tension (capillary forces) which can generate a flow in the bulk. There are many applications of this problem for natural and industrial processes such as crystal growth or mixture drying (salty lakes, painting, inking or packaging). The moving contact line between two immiscible fluids and a solid surface under evaporation (liquid coating) is studied using an analytical approach. The flow in a water drop under Leidenfrost effect is also investigated with numerical tools.

Thermocapillary convection

Producing a high-quality crystal is often done with a floating-zone technique (see left figure). A feed-rod melts as it passes through a High Frequency inductor heater. As the melt solidifies on a germ, a crystal grows. In this containerless technique the flow is mainly driven by thermocapillary convection which is generated by the temperature gradient along the large free surface. The rotation of the feed-rod and crystal is an effective way to control the flow at the solidification front which determines the quality of the crystal. A linear stability analysis of three-dimensional perturbations is performed and shows that for any ratio of angular velocities, weak rotation rate has a surprising effect of destabilisation. The aim of the work is to explain the basic effect of rotation on the thermocapillary flow (collab. L. Martin Witkowski and L. Kahouadji with J.S Walker at Urbana Champaign, Illinois and B. Houchens at Rice University, Houston, Texas).

Experimental results on the drying of a Polyisobutylene/Toluene solution have shown that several convective transient regimes follow one another in time: at the beginning of drying, a thermal transient regime is observed followed by a solutal transient regime. The onset of convection (Bénard-Marangoni and Rayleigh-Bénard) is studied for a large range of initial thicknesses and viscosities. Two-dimensional (2D) and three-dimensional (3D) models are shown to give similar results. The 3D model is used to characterize the pattern evolution during the drying (see right figure). In the case of surface tension driven convection, a method has been developed to describe the cells morphology and their time evolution (collab. C. Dang Vu-Delcarte and B. Trouette with E. Chénier at MSME-UPEMLV and B. Guerrier at FAST).

Solutal convection

Evaporation of the solvent induces an increase in the solute concentration close to the free surface and solutal gradients can induce a convective flow driven by buoyancy and/or surface tension. This problem is studied numerically, using several assumptions deduced from previous experiments on polymer solutions. The stability of the system is investigated as a function of the solutal Rayleigh and Marangoni numbers, the evaporative flux and the Schmidt number. The sensitivity of the thresholds to the initial perturbation is also analyzed. The effect of viscosity variation during drying is investigated. Finally, numerical simulations have been performed to study the competition between buoyancy and Marangoni effects in the nonlinear regime (collab. C. Dang Vu-Delcarte and B. Trouette with E. Chénier at MSME, F. Doumenc and B. Guerrier at FAST).
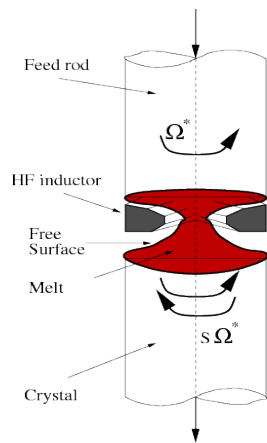
Scheme of a high-frequency heated float-zone process
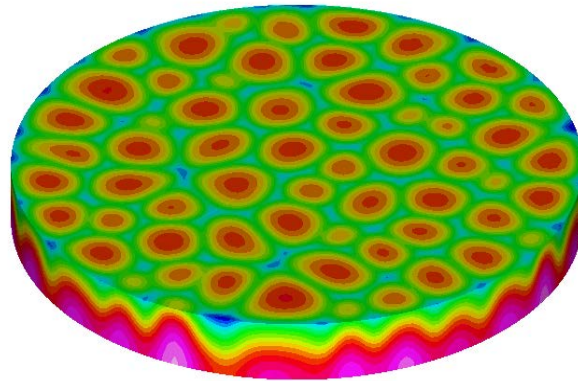
Rayleigh-Bénard-Marangoni convection: temperature field (warm fluid in red, cold fluid in blue, Ra=150, Ma=1950, Pr=12, Bi=0.2).

Moving contact line under evaporation

Understanding the dynamics of a moving contact line in the presence of evaporation is a key problem for instance in coating processes using solutions that are drying. The problem is complicated for it involves both a hydrodynamical and an evaporative singularity at the contact line. We propose a model of moving contact line under evaporation in partial or complete wetting situations that takes into account the divergent evaporative flux near the contact line. Analytical calculations together with numerical simulations lead to a generalization of Cox-Voinov wetting laws that relate the macroscopic apparent contact angle to the speed of the contact line. In the case of complete wetting, a disjunction pressure term due to van der Waals interactions between the substrate and the liquid is considered and the existence of a precursor film is shown. Its length and thickness are calculated, which both depend on Hamaker constant and evaporative flux (collab. C.-T. Pham with F. Lequeux at ESPCI and L. Limat at University Paris Diderot).

Leidenfrost liquid torus

When a drop of volatile liquid is deposited on a very hot surface, it can levitate above its own vapor. This effect is called the Leidenfrost effect. Leidenfrost drops are limited in volume, and beyond a critical volume, chimneys appear inside the liquid puddle. However it has been shown experimentally that this volume limitation could be circumvented by creating a large liquid torus using half-donut-shaped hot substrates. In this configuration, two distinct flow regimes exist: a flow with convection cells or a toroidal flow with polygonal patterns. We numerically study the structure of such free surface flows together with the dependence of these flows with respect to different physical parameters: the shape of the liquid torus, the Marangoni number, the Rayleigh number (collab. C.-T. Pham at LIMSI, Y. Couder and L. Limat at University Paris Diderot).

Topic 3: Rotating and shear flows

I. Delbende, L. Martin Witkowski, Y. Duguet, P. Le Quéré, O. Daube

We study flows for which the effects of rotation and/or shear are dominant. Vortices are typical features of the wakes of rotating devices such as propellers, wind turbines and helicopter rotors, known to affect their stability. Predicting three-dimensional instabilities of helical vortices is a prerequisite for a control strategy. Numerical prediction of the bifurcations inside a rotating disk flow with a free surface is performed and compared to experimental results. The abrupt transition to turbulence in near-wall flows strongly affects the viscous drag and thus the energetic performances in the context of aeronautics or oil transport. This phenomenon is investigated numerically in the Blasius boundary layer, Plane Couette flow and in cylindrical pipe flow.

Simulation of flows with a helical symmetry

The wakes of rotating devices such as propellers, wind turbines and helicopter rotors are dominated by helical vortices. These structures result from the rapid roll-up of the vorticity sheets continuously generated

at the trailing edge of the rotating blades, and are experimentally shown to be prone to several instability processes. In order to characterize such helical vortex systems, an original code has been recently developed at LIMSI, which enforces the helical symmetry into the incompressible Navier-Stokes equations (collab. I. Delbende and O. Daube with M. Rossi at IJLRA, UPMC). The simulation of any helically symmetric flow is then reduced to solving a 2D problem which fully takes into account 3D vortex curvature and torsion effects. This allows for higher Reynolds numbers and longer simulation times. The resolution technique is based on a generalized vorticity-stream function formulation inside a circular domain, discretized using finite differences in the radial direction and a spectral Fourier decomposition in the azimuthal one. The code has been successful at characterizing quasi-steady viscous helical flow states with 1 or 2 vortices and in simulating the merging dynamics of two helical vortices (Ph.D thesis of B. Piton): four different mechanisms have been identified when the helical pitch and the Reynolds number are varied. A project has been submitted to ANR to investigate three-dimensional instabilities in such systems, together with IRPHE (Marseille, Th. Leweke).
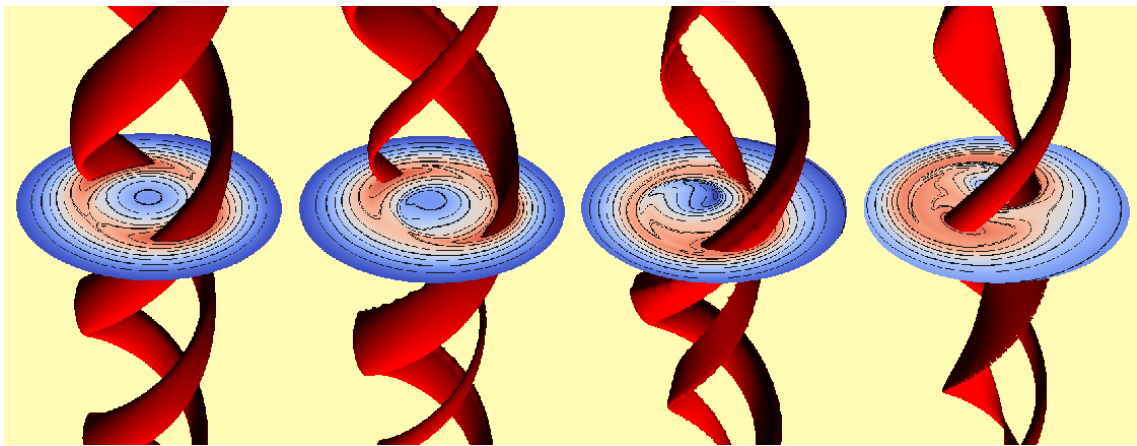
Temporal evolution of two helical vortices at low pitch before merging. Isocontours of helical vorticity in the 2D computational domain and corresponding 3D vortex structure.

Free surface rotating disk flows

The flow driven by a rotating disk located at the bottom of a fixed open cylindrical cavity exhibits a wide variety of instability patterns. Numerical tools have been developed in order to accurately predict the associated thresholds and to reproduce the patterns observed after the primary bifurcation. In most cases, assuming the free surface to be flat leads to a good agreement with the experiments conducted at IRPHE (Marseille). However, for a thin layer of fluid, a discrepancy exists and the deformation of the surface has to be accounted for. A code that computes the free surface shape has been developed during Lyes Kahouadji's Ph. D thesis. Direct numerical simulations were also performed in order to characterize the bifurcations above the first instability threshold. This project is the basis of collaboration between L. Martin Witkowski and L. Kahouadji with S. Poncet and E. Serre at M2P2 (Marseille)
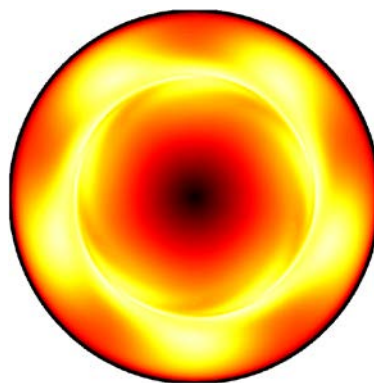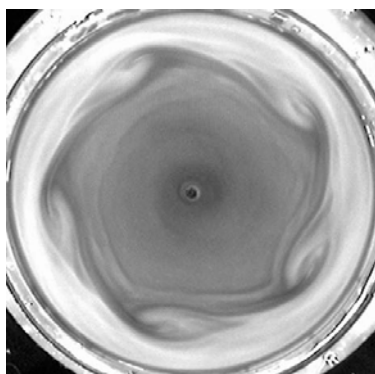
Flow structure at a Reynolds number slightly above the first instability threshold. An azimuthal mode 5 is dominant in the experiment conducted at IRPHE (left) and reproduced via a linear stability analysis (right).

Subcritical transition to turbulence in shear flows

Transition to turbulence in wall-bounded flows is a notoriously challenging topic. Further conceptual difficulties arise in the subcritical case, i.e. when transition occurs in the absence of linear instability of the base flow, e.g. in cylindrical pipe flow, plane Couette flow (the flow between two counter-sliding plates) or in the Blasius boundary layer over a flat plate. Two different approaches are considered for those flows, both relying on extensive spectral direct numerical simulations. The first one, inspired by dynamical systems theories, relies on the identification of the edge state, the unstable regime delimitating laminar from turbulent motion in the associated phase space. These coherent states appear to be invariably localised in space, actual transition occurring through their spatial expansion. The second one revolves around the possible formation of large-scale patterns during the later transition stage, featuring spatial coexistence of both laminar and turbulent zones. This work forms the basis of a regular collaboration between Y. Duguet with the team of D. Henningson at KTH (Stockholm, Sweden) and B. Eckhardt at Philipps-Universität Marburg (Germany).
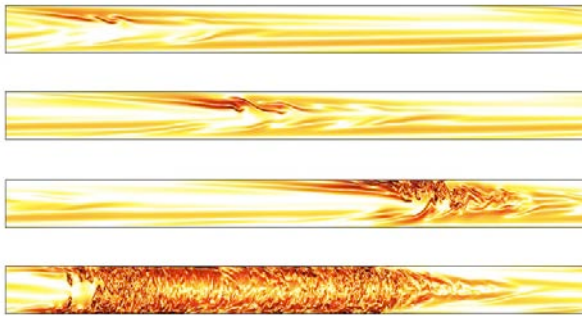
Isosurfaces of azimuthal vorticity during the escape from the edge state and the formation of a turbulent slug in cylindrical pipe flow (Re=3000, flow from left to right).

Topic 4: Magnetohydrodynamics (MHD)

C. Nore, W. Herreman

The motion of electrically conducting liquids couples the velocity and magnetic fields through the Lorentz force and Ohm's law and can lead to dynamo action, namely the conversion of kinetic energy into magnetic energy. We study this effect in wave-like flows and in different configurations within finite containers: rotating disks, precession, rotation of the walls.

Dynamo action in finite containers

The interest of astronomers and physicists for the dynamo action finds its origins in the quest for a reasonable explanation for the source of terrestrial and solar magnetism. Dynamo action is obtained when the conversion rate of kinetic energy into magnetic energy in the Earth liquid core is larger than the Ohmic dissipation. This phenomenon is turbulent and reproducing it either numerically or experimentally constitutes an enormous challenge. To tackle this challenge, since 2003, we have developed a finite element code integrating the MHD equations (Navier-Stokes equations coupled with the Maxwell equations).

This code has been validated on different test cases in two and three space dimensions (collab. C. Nore at LIMSI, J. Léorat at LUTH, Meudon and J.-L. Guermond at TAMU, Texas). A new method has been developed to take into account abrupt spatial distributions of electrical conductivity and magnetic permeability (PhD thesis of F. Luddens). This technique allows us to study the impact of ferromagnetic materials or conducting walls on the magnetic field. For example, the use of ferromagnetic disks in a model of the Von Kármán Sodium experiment enhances the axisymmetric magnetic field located in the disks. Other studies have been conducted in confined cavities filled by electrically conducting liquids: propagation and reflection of Alfvén waves in a cylinder in relation with the experimental set-up Galalfvén (ISTerre, Grenoble, T. Alboussière et al.); dynamo action in a precessing cylinder (in relation with the DRESDYN facility currently built in Dresden, Germany, F. Stefani et al.) and in a Couette-Taylor set-up (experiment in New Mexico, USA, S.A. Colgate et al.).
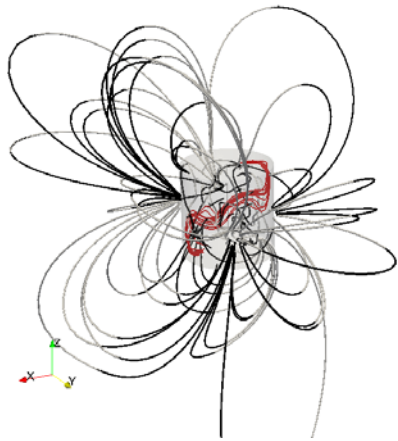
Nonlinear dynamo in a precessing cylinder: vorticity field lines in the conducting fluid (red) and magnetic field lines in the fluid and the vacuum (positive vertical component in black, negative in grey).

Stokes drift can drive a dynamo

In a fluctuation flow, typically a wave-like flow, fluid particles can move on average even when the Eulerian mean flow vanishes everywhere in space. This phenomenon is known since 1847, when Stokes discovered it in the gravity wave context. In a recent study (collab. W. Herreman with P. Lesaffre at LRA-ENS) we show that this drift plays a crucial role in the problem of magnetic field generation (dynamo) by a fluctuation flow of electrically conducting liquids. It appears that the Stokes drift controls the dynamo as if it were an Eulerian mean flow. We have tested this model on a class of wave-like flows whose associated Stokes drift is a well-known dynamo flow (Roberts 1972). The left panel of the figure illustrates the Stokes drift idea. A Lagrangian particle (solid line) placed in the wave-like flow moves on average along the streamlines (dashed lines) of the corresponding Stokes drift. The magnetic field generated by the waves (middle panel) is very close to the one which would be generated by the Stokes drift (right panel).
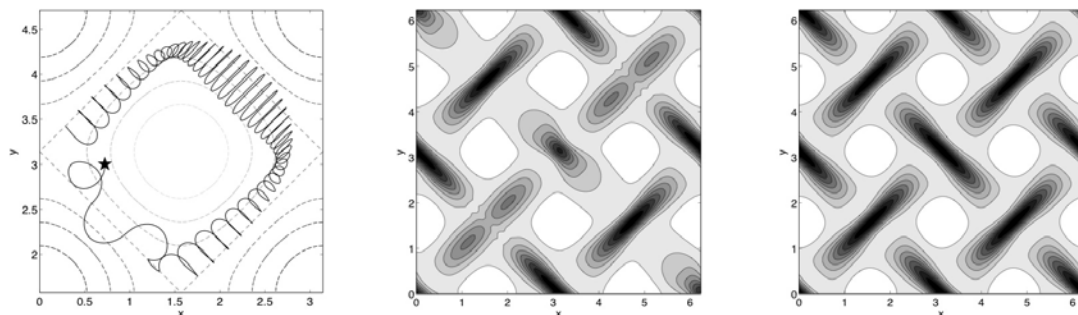
Lagrangian particle trajectory (left), magnetic field generated by the waves (middle) or generated by the Stokes drift (right).

Topic 5: Numerical methods

C. Dang Vu-Delcarte, Y. Duguet, G. Labrosse, P. Le Quéré, L. Martin Witkowski, A. Sergent

Reduced models for confined flows

The goal of this study is to set the foundations for a technique that will allow identifying stability threshold and predicting the behavior in the weakly nonlinear regime of three dimensional flows at a moderate computational cost. Techniques such as the Newton-Arnoldi method applied to Navier-Stokes equations are very effective but become too costly when the flow is three-dimensional. In order to reduce the number of degrees of freedom (typically 10^6 for three dimensional simulations) to less than 50, the discretized partial differential equations are reduced to several coupled ordinary differential equations in the following way. Few selected eigenvectors are computed via the Newton-Arnoldi method, then a Galerkin projection of Navier-Stokes equations on this basis of eigenvectors is performed. Time integration of the ordinary differential equations is extremely fast and allows one to integrate for longer times and/or to explore a wider range of parameters. The correct choice for the eigenvectors is crucial for correctly

reproducing the dynamical behavior of the full system. The Rayleigh-Bénard convection problem in a cylinder of aspect ratio one where the lower and upper disks, maintained at hot and cold temperatures, respectively, rotate at equal and opposite angular velocities has been chosen to test this technique. The associated nonlinear dynamics is rich and complex when the temperature difference between the disks and their angular velocity is varied, as described in the topic thermal convection (collab. L. Martin Witkowski with M. C. Navarro at UCLM, Spain and L. S. Tuckerman at PMMH).

Discretized diffusion operator

Chebyshev or Legendre pseudo-spectral methods are of common use for solving equations of momentum, heat and/or mass transfer. Temporal discretization of these equations often leads to elliptic Helmholtz problems. When these multidimensional elliptic problems are separable, their numerical solution can be efficiently obtained using the Successive Diagonalization Technique. This approach amounts to working inside the Helmholtz operator numerical eigenspace, itself being constructed from the tensorial product of eigenspaces of the 1D second derivatives. The discrete Chebyshev Gauss-Radau version of the polar-diffusion operator displays complex eigenvalues with negative real parts when it is associated to a Neumann boundary condition. It is shown that this marginal violation of the original continuous problem is genuine and not due to some amplification of round-off errors. The impact on the ellipticity and on the numerical accuracy of a computed flow of a particular mapping, leading to slight changes in the mesh, is evaluated (collab. C. Dang Vu-Delcarte, G.Labrosse and B. Trouette).

The Stokes eigenmodes are fundamental solutions of flows dominated by diffusion. An accurate determination of the Stokes eigenmodes can also shed light on the dynamics of turbulent flows near solid boundaries. In the case of no-slip boundary conditions in a closed Cartesian cavity, these modes cannot be obtained analytically but only numerically. They are calculated by both pseudo-spectral Chebyshev and Lattice Boltzmann methods (collab. G. Labrosse and P. Lallemand with E. Leriche at Saint-Etienne University).

Spectral methods are well recognized for their high accuracy but a major restriction is that they are limited to orthogonal geometries. Fourier and Chebyshev theoretical analyses of all the low-order (3-nodes) Finite Difference, Finite Element and Finite Volume preconditionings of d^2u/dx^2 are performed. It is shown that the piecewise-linear Finite Volume approximation provides the best 3-nodes preconditionning of the d^2u/dx^2 Chebyshev spectral operator.

Boundary conditions for natural convection with openings

For flows in open or semi-infinite configurations, the prescription of appropriate boundary conditions on the frontiers of the computational domain is a key issue for the relevance and quality of simulations. This question has been the subject of numerous studies, which have been generally concentrated on the outlet boundary, the issue of the inlet boundary condition being deemed less difficult. If this is the case for forced convection configuration, it is not so trivial for situations where the driven force of the flow depends on the conditions inside the computational domain. In that case what happens on the inlet boundary is unknown and therefore cannot be imposed a priori. The vertical channel is considered as a prototype configuration of such flows. A benchmark organized within the French community has revealed a significant scatter amongst the solutions, which questions the well-defined character of the problem. This issue was addressed by investigating the kernel modes of the associated discrete Stokes operator. The singular value decomposition of this operator is used to characterize the kernel size, which in the best case must be reduced for a staggered grid to the well-known trivial mode: the pair zero velocity/constant pressure. When the kernel size is greater than one, the solution of the nonlinear problem may be determined as a linear combination of both a particular solution and the kernel modes by imposing additional conditions, equal in number to the dimension of the kernel (Ph.D thesis of C. Garnier).
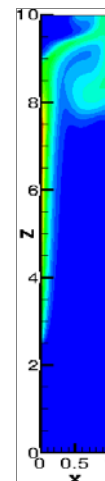
Unsteady development of the temperature field for a vertical channel asymmetrically heated at constant heat flux, $Ra=10^5$.

Particle tracking methods for transitional flows

Tracking of passive tracers is fundamental for the understanding of Lagrangian mixing in fluid flows. Lagrangian methods lie at a crossroad between classical hydrodynamics and recent dynamical systems

theories. High-order numerical techniques for the tracking of point particles adapted to spectral methods were implemented in a spectral Direct Numerical Simulation code developed at LIMSI for the flow inside a two-dimensional differentially heated cavity. As the base flow loses its stability and becomes time-periodic, the topology of the particle flow in a stroboscopic Poincaré section is investigated with an emphasis on detecting homoclinic points. This criterion will be used to diagnose the appearance of Lagrangian chaos within the framework of the Smale-Birkhoff theorem. This work is performed in close collaboration between Y. Duguet, L. Oteski (PhD student) and L. Pastur from the AERO group and is funded by the EADS Foundation.

Highlights

- Validation of the first nonlinear magnetohydrodynamics simulation code including geometric singularities and discontinuous physical properties (magnetic permeability and electrical conductivity). Application to the analysis of the role of ferromagnetic materials in the Von Kármán Sodium experiment.
- Development of an innovative direct simulation code for the investigation of a special class of flows with helicoidal symmetry, including the systems of helical vortices with applications to aeronautics, wind turbine aerodynamics and propulsion.
- Theoretical link established for the first time between the Lagrangian Stokes drift and the generation of a magnetic field in wave-like flows.
- Progress in the fundamental understanding of subcritical transition to turbulence in wall-bounded flows, via the computation of exact coherent structures. Novel approach attested by the selection for Research Highlights in Physics of Fluids (Y. Duguet, P. Schlatter, D.S. Henningson, Localized edge states in plane Couette flow, PoF, 21 (2009), 111701) and the front cover of Journal of Fluid Mechanics (Y. Duguet, A.P. Willis, R.R. Kerswell, Slug genesis in cylindrical pipe flow, JFM, 663, 180-208 (2010)).
- Solving the longstanding discrepancy between experimental and numerical results (stratification and flow) of turbulent natural convection in differentially heated cavities, by adding a full thermal coupling at walls in a pure convection 3D code.
- Building a reduced model able to capture rich and complex non-linear dynamics for flow in a confined geometry.

Staff

Permanent staff

Firstname	Lastname	Type of position	Employer	HDR	Arrival date	Departure date
Claudine	Dang Vu	Prof.	U-PSud	HDR		
Ivan	Delbende	Ass. Prof.	UPMC	HDR		
Yohann	Duguet	CR	CNRS			
Wietze	Herreman	Ass. Prof.	U-PSud		Hired as of 01/09/2010	
Gérard	Labrosse	Prof.	U-PSud	HDR		Retired on 31/08/2011
Patrick	Le Quéré	DR	CNRS	HDR		
Laurent	Martin Witkowski	Ass. Prof.	UPMC			
Caroline	Nore	Prof.	U-PSud	HDR		
Chi-Tuong	Pham	Ass. Prof.	U-PSud			
Anne	Sergent	Ass. Prof.	UPMC			
Catherine	Weisman	Ass. Prof.	UPMC			

PhD Students

Firstname	Lastname	Graduate school	University	Type of support	Start date	Date of defense
Zhenlan	Gao	SMAER	UPMC	UPMC PhD grant	01/12/2010	
Charles	Garnier	SMAER	UPMC	UPMC PhD grant	01/09/2011	

Lyes	Kahouadji	SMAER	UPMC	MNRT PhD grant	01/10/2007	24/10/2011
Francky	Luddens	Matière Condensée et Interfaces	U-PSud	U-PSud PhD grant	01/09/2009	
Lin	Ma	SMAER	UPMC	UPMC PhD grant	01/10/2011	
Ludomir	Oteski	MIPEGE	U-PSud	CDD CNRS/EADS	01/10/2011	
Benjamin	Piton	SMAER	UPMC	MNRT PhD grant	01/10/2008	21/10/2011
Adolfo	Ribeiro	Physique Macros.	U-PSud	MNRT PhD grant	01/10/2006	28/06/2010
Huong-Lan	Tran	SMAER	UPMC	CDD CEA	07/12/2009	
Benoit	Trouette	Physique Macros.	U-PSud	MNRT PhD grant	01/10/2007	09/12/2010

Non permanent staff

Firstname	Lastname	Type of position	Employer	Arrival date	Departure date
Sid Ali	Litim	External collaborator	Univ. Oran	07/10/2010	06/01/2011
Benoit	Trouette	Post-Doc	CNRS	10/12/2010	31/08/2011

Indicators of scientific notoriety

Prizes and awards

- C. Nore is a junior member of Institut Universitaire de France, section Sciences pour l'Ingénieur, since 2008.
- W. Herreman received the price for the best oral presentation by SFP, Orsay, Colloque Alain Bouyssy, Université Paris-Sud, February 2011.

Editorial board appointment

- C. Dang Vu-Delcarte is co-Editor of volume 192 of the European Physical Journal Special Topics.
- P. Le Quéré is on the editorial board of Int. J. Thermal Sciences

Organization of international or national scientific events

Member of the scientific, technical program and/or organizational committees for international/national conferences or workshops

- C. Dang Vu-Delcarte and C.-T. Pham co-organized the 5th Conference of the International Marangoni Association on Interfacial Fluid Dynamics and Processes (IMA5-Florence June 7-10 2010).
- C. Dang Vu-Delcarte Delcarte is a member of the organizing committee of IMA6 (Haifa 2012).
- C. Nore co-organized the session Magnéto-électro hydrodynamique et Fluides géophysiques at Congrès Français de Mécanique held in Besancon, August 28-September 2 2011 (with M. Le Bars of IRPHE, Marseille).
- C. Weisman co-organized with D. Baltean-Carlès the 2008 workshop of the GDR Thermoacoustique held at LIMSI, on December 15-16 2008 (40 participants).
- P. Le Quéré and A. Sergent were members of the organizing committee (LIMSI) of the 11ème école thématique de Mécanique des Fluides Numérique MFN2009 on the topic « Transferts en écoulements dominés par la Convection » held in Oléron, June 7-13 2009.
- C. Weisman, I. Delbende and P. Le Quéré were members of the organizing committee (LIMSI) of the first summer school (endorsed by CNRS) on Thermoacoustics, held in Roscoff, May 30-June 4, 2010 (42 participants). P. Le Quéré was also a member of the scientific committee.
- A. Sergent was a member of the organizing committee (LIMSI) of the 12ème école thématique de Mécanique des Fluides Numériques MFN2011 on the topic « Méthodes et algorithmes pour le calcul hautes performances » held at Roscoff, June 5-11 2011.
- P. Le Quéré is member of the scientific committee of ExHT Int. Conference

Invited lectures, talks or seminars

Keynote speaker at an international conference

- C. Nore was a keynote speaker at EUROMECH colloquium: Instabilities and transition in three-dimensional flows with rotation, Lyon, June 21-23 2011, organized by B. Pier.

Invited workshop speaker

- L. Martin Witkowski was invited at II Jornada Sobre Inestabilidades Hydrodynamicas, Ciudad Real, Spain (April 2009).

- Anne Sergent presented Large eddy simulations of large-scale patterns in a rectangular Rayleigh-Bénard cell, at EUROMECH colloqium #520 "High Rayleigh Convection" - 3th International Workshop on Rayleigh-Bénard Convection, Les Houches, France, 24-29 Janvier 2010.

Tutorial at workshops or conferences or summer schools

- I. Delbende gave a « Short lecture : Instabilités hydrodynamiques. » 1st School in Thermoacoustics (CNRS), Roscoff, France, 2010.

Invited talk (national or international)

- I. Delbende, Vortex : dipôles et reconnexion, Séminaire de l'ONERA-DAFE, Meudon, 2009.
- I. Delbende, Vortex : dipôles et reconnexion, Séminaire de l'ENSTA, Palaiseau, France, 2009.
- I. Delbende, Dynamique de vortex hélicoïdaux, Séminaire de l'IJLRA, Paris, France, 2012.
- Y. Duguet, Large scale turbulent patterns in plane channel flows, Department of Mechanical Engineering, Osaka University, Osaka, Japan, 2011.
- Y. Duguet, Large scale turbulent patterns in plane channel flows, RTG, Lorentz Force Group, Technische Universität Ilmenau, Ilmenau, Germany, 2011.
- Y. Duguet, Etats limites dans les écoulements cisaillés sous-critiques, SINUMEF, ENSAM Paris, Paris, France, 2011.
- Y. Duguet, Co-existence laminaire/turbulent dans un écoulement de Couette plan, LOMC, Université du Havre, Le Havre, France, 2011.
- Y. Duguet, Transition vers la turbulence en conduite cylindrique : progrès récents, Séminaire de mécanique théorique, IJLRDA, UPMC, Paris, France, 2010.
- Y. Duguet, Structures localisées en écoulement de Couette plantransitionnel, Séminaire de l'ENSTA - Invitation de Romain Monchaux, Palaiseau, France, 2010.
- Y. Duguet, Laminar-turbulent coexistence in plane Couette flow, Max Planck Institute for Dynamics and Self-Organization, Göttingen, Germany, 2010.
- Y. Duguet, Edge states in boundary layer flows, Fachbereich Physik, Phillips Universität Marburg, Marburg, Germany, 2010.
- Y. Duguet, Localised structures in transitional plane Couette flow, School of Mathematics, University of Bristol. Invitation de Rich Kerswell, Bristol, UK, 2009.
- Y. Duguet, Transition sous-critique dans les écoulements cisaillés: une approche non linéaire, Séminaire ONERA-DAFE, Meudon, France, 2009.
- L. Martin Witkowski, Instabilités d'écoulements engendrés par des disques tournants, Séminaire M2P2, Marseille, France, 2011.
- C. Nore, Une nouvelle approche spectrale-éléments finis pour la magnétohydrodynamique en domaine borné hétérogène, Séminaire IRPHE, Marseille, France, 2010.
- C. Nore, A finite element approach of nonlinear MHD problems in heterogeneous domains, Séminaire à l'École centrale de Lyon, France, 2010.
- C. Nore, Simulations numériques de dynamos fluides, Séminaire au LUTH, France, 2011.
- A. Sergent, Vers une stratification thermique cohérente avec l'expérimentation : cas de la convection naturelle turbulente en cavité différentiellement chauffée, Congrès Français de Mécanique, Session thermique, Besançon, August 28-September 2 2011.

Participation in expertise and administration of research

International or national scientific networking

International networks

- Y.Duguet participates in an exchange program EGIDE-SAKURA with Japan, headed by P. Manneville (LadHyX, Ecole Polytechnique, Palaiseau) and G. Kawahara (Université d'Osaka, Japan).
- C. Weisman participates in the CMEP program 10MDU809 (P. Le Quéré heads up the program) for a French-Algerian collaboration on «A numerical and experimental study of thermoacoustic systems» (2010-2014), within the framework of the Hubert Curien Tassili program (8840 € in 2010, 10535 € in 2011, for covering travel and sustenance of the Algerian partners in France).
- P. Le Quéré is member of the Scientic Council of Int. Center For Heat and Mass Transfer

National networks or working groups

- Members of the group take part to various national networks such as GdR Dynamo, AMETH, Turbulence, Dycoec, Thermoacoustique, Films cisaillés.
- Members of the group participate in the Fédération «Transferts de masse et de chaleur» : Topic 3 «Instabilités thermoconvectives» on the subject of Non Boussinesq convection.

Participation in evaluation or expertise committees

National committees (CoNRS, CNU, CCSU…)

- C. Dang Vu-Delcarte, C. Nore and C.T. Pham are members of CCSU 60-61-62 of Paris-Sud University.
- C. Dang Vu-Delcarte was member of the Département de Physique of Paris-Sud University (up to 2011).
- C.-T. Pham is member of the Conseil Scientifique of the Physics Department of Paris-Sud University.
- A. Sergent is member of CCSU 60 of UPMC.
- C. Weisman has been a member since 2008 of the « Conseil des enseignements » of the « UFR 919 (Ingénierie) » at UPMC.
- I. Delbende was member of CCSU 60 of UPMC (2009-2011).

Expert for scientific evaluation committees

- P. Le Quéré is member of Scientific Council of CERFACS
- P. Le Quéré is member of CEO of ONERA

Member of the administration or advisory board

- I. Delbende was elected on the advisory board of the Engineering Faculty of UPMC up to 2011.
- P. Le Quéré was head of the CNRS Energy Interdisciplinary program from 2009 to the end of 2011.
- P. Le Quéré is part of the Steering Committee of the ANR SEED Program

Member of selection juries

- Y. Duguet was member of 2 Comités de Sélection Maîtres de conférences at UMLV, May 2011.
- C. Dang Vu-Delcarte, C.-T. Pham and C. Nore were members of Comité de Sélection Maître de Conférences CNU 60 in June 2010, Paris-Sud 11 University.
- C. Nore was member of Comité de Sélection Maître de Conférences-Chaire CNU 34/60, May 2011, Nice.
- C. Nore is member of Comité de Sélection Maître de Conférences CNU 60 at ENS Cachan, May 2012, Paris.
- C. Dang Vu-Delcarte and C. Nore are members of Comité de Sélection Professeur des Universités CNU 60 at Paris-Sud 11 University, May 2012.
- A. Sergent is member of Comité de Sélection Maître de Conférences CNU 60 at UPMC, May 2012.
- L. Martin Witkowski was member of Comité de Sélection Maîtres de Conférences CNU 60/62 at Université d'Evry Val d'Essonne, May 2010.

Teaching activities and duties in relation to research

- C. Dang Vu-Delcarte is co-director of the Master Physique Appliquée et Mécanique Physique of University Paris-Sud and of the Speciality M2 DFE Dynamique des Fluides et Energétique.
- C. Nore teaches MagnetoHydroDynamics at master 2 level at University Paris-Sud.
- C.-T. Pham teaches a course on Hamiltonian Mechanics for M1 students at University Paris-Sud.
- C.-T. Pham (course head) teaches courses on Numerical Methods for CFD, Finite Element Methods, Programming and Code Development for M2 students at University Paris-Sud.
- I. Delbende teaches (with M. Rossi, CNRS) a course on « Vortices in hydrodynamics » (M2, Master SDI, MF2A, UPMC).
- I. Delbende (course head) teaches (with J.-C. Chassaing, UPMC) a course on « Fundamental Aerodynamics» (M1, Master SDI, MF2A, UPMC).
- I. Delbende teaches (with S. Kouidri, UPMC) a course on « Renewable Energy Engineering » (M1, Master SDI, EE/MF2A, UPMC).
- I. Delbende teaches (with V. Bourdin) a course on « Solar and Renewable Energies » (M2, Master PIE, Paris-Sud 11 University).
- L. Martin Witkowski (course head) teaches numerical methods at master 2 level at UPMC.
- A. Sergent (course head) teaches a course on « Heat transfer for building engineering» (M2, Master SDI, EE, UPMC).
- C. Weisman teaches (with T. Gomez, IJLRDA) a course on « Numerical methods for Mechanical Engineers » (M1, Master SDI, MF2A, UPMC).
- A. Sergent (course head) and C. Weisman teach a computer laboratory course (M1, Master SDI, MF2A, UPMC).
- C. Weisman teaches (with B. Goyeau, ECP) a course on « Heat transfer and flow in fluid and porous media » (M2, Master SDI, MF2A, UPMC).

Dissemination and vulgarization

- I. Delbende is supervisor of classe préparatoire students (TIPE).

Research conventions and contracts

Valorization

One simulation platform OLORIN has been developed by CIGITA team on the bais of the know-how in numerical algorithms for incompressible and low-mach number flows. A licence has been filed whose co-inventors are Y. Fraigneau, P. Le Quéré, A. Sergent and B. Podvin.

Industrial relationships

- CORO is involved in an industrial collaboration with CEA, on the theme of the Hydrogen risk.

Contract table

Acronym	Funding agency/Partner	Program	Nature	Resp. for LIMSI	General coordinator	Starting date	Ending date	LIMSI share
	IUF	IUF Junior member	Research support	Nore C.	Nore C.	01/09/2008	31/08/2013	15245/y
FED EM2C-TMC	ECP		other	Le Quéré P.	Soufiani A. (EM2C)	01/05/2009	30/04/2010	16722
	CNRS	PICS Coopération avec la Chine	Research collab.	Le Quéré P.		01/01/2010	31/12/2010	4400
Energie	CNRS	Programme interdisciplinaire Energie	Research support	Le Quéré P.	Le Quéré P.	01/01/2010	31/12/2011	39000
COCORAPHA 2	CNRS	Programme interdisciplinaire Energie	Research support	Sergent A.	Xin S. (CETHIL)	01/01/2010	31/12/2011	8000
PLASBorDDIAM	ANR	Basic Science	Research collab.	Le Quéré P.	Gicquel A. (LSMP)	01/09/2011	31/08/2015	115544
	EADS	PhD grant	Research collab.	Duguet Y.	Duguet Y.	15/12/2011	31/12/2015	132000

Scientific publications

Doctoral theses and HDR

T1. Delbende, I., *Simulation numérique de systèmes tourbillonnaires : dynamique et instabilités*, 2011, HDR de l'Université Pierre et Marie Curie, soutenue au LIMSI, Orsay, le 13 décembre 2011. 231 p.

T2. Kahouadji, L., *Analyse de stabilité linéaire d'écoulements tournants en présence de surface libre* 2011, thèse de l'Université Pierre et Marie Curie. Soutenue au LIMSI, Orsay, le 24 octobre 2011, 218 p.

T3. Piton, B., *Simulations de tourbillons à symétrie hélicoïdale* 2011, thèse de l'Université Pierre et Marie Curie. Soutenue au LIMSI, Orsay, le 20 octobre 2011, 139 p.

T4. Ribeiro, A., *Approche spectrale/éléments finis pour des problèmes de magnétohydrodynamique non linéaires* 2010, thèse de l'Université Paris-Sud. Soutenue au LIMSI, Orsay, le 30 juillet 2010, 172 p.

T5. Trouette, B., *Instabilités de Rayleigh-Bénard-Marangoni, induites par évaporation, en régime transitoire - Application aux solutions polymères* 2010, thèse de l'Université Paris-Sud. Soutenue au LIMSI, Orsay, le 9 décembre 2010, 186 p.

Articles in peer reviewed scientific journals

A1. Alboussière, T., P. Cardin, F. Debray, P. La Rizza, J.-P. Masson, F. Plunian, A. Ribeiro, and D. Schmitt, *Experimental evidence of Alfvén wave propagation in a Gallium alloy.* Physics of Fluids, 2011. **23**: pp.096601_1-096601-10.

A2. Bordja, L., L. Tuckerman, L. Martin Witkowski, M.C. Navarro, D. Barkley, and R. Bessaih, *Influence of counter-rotating von Karman flow on cylindrical Rayleigh-Bénard convection.* Physical Review E, 2010. **81** (3): pp.036322_1-036322_16.

A3. Boronska, K. and L. Tuckerman, *Extreme multiplicity in cylindrical Rayleigh-Bénard convection. I. Time dependence and oscillations.* Physical Review E, 2010. **81** (3): pp.036320_1-036320_13.

A4. Daru, V., P. Le Quéré, M.-C. Duluc, and O. Le Maitre, *A numerical method for the simulation of low Mach number liquid-gas flows.* Journal of Computational Physics, 2010. **229** (23): pp.8844-8867.

A5.   Duguet, Y., L. Brandt, and B.R.J. Larsson, *Towards minimal perturbations in plane Couette flow.* Physical Review E, 2010. **82**: pp.026316_1-026316_13.

A6.   Duguet, Y., O. Le Maitre, and P. Schlatter, *Stochastic and deterministic motion of a laminar-turbulent front in a spanwisely extended Couette flow.* Physical Review E, 2011. **84**: pp.066315_1-066315_14.

A7.   Duguet, Y., P. Schlatter, and D. Henningson, *Formation of turbulent patterns near the onset of transition in plane Couette flow.* Journal of Fluid Mechanics, 2010. **650**: pp.119-129.

A8.   Duguet, Y., A. Willis, and R. Kerswell, *Slug genesis in cylindrical pipe flow.* Journal of Fluid Mechanics, 2010. **663**: pp.180-208.

A9.   Duguet, Y., A. Willis, and R. Kerswell, *Etats limites et bouffées turbulentes en conduite cylindrique.* Mécanique & Industries, 2010. **11**: pp.157-162.

A10.   Giesecke, A., C. Nore, F. Plunian, R. Laguerre, A. Ribeiro, F. Stefani, G. Gerbeth, J. Léorat, and J.-L. Guermond, *Generation of axisymmetric modes in cylindrical kinematic mean-field dynamos of VKS type.* Geophysical & Astrophysical Fluid Dynamics, 2010. **104** (2): pp.249-271.

A11.   Giesecke, A., C. Nore, F. Stefani, G. Gerbeth, J. Léorat, F. Luddens, and J.-L. Guermond, *Electromagnetic induction in non-uniform domains.* Geophysical & Astrophysical Fluid Dynamics, 2010. **104** (5): pp.505-529.

A12.   Guermond, J.-L., J. Léorat, F. Luddens, C. Nore, and A. Ribeiro, *Effects of discontinuous magnetic permeability on magnetodynamic problems.* Journal of Computational Physics, 2011. **230** (16): pp.6299-6319.

A13.   Herreman, W. and P. Lesaffre, *Stokes drift dynamos.* Journal of Fluid Mechanics, 2011. **679**: pp.32-57.

A14.   Hireche, O., C. Weisman, D. Baltean, P. Le Quéré, and L. Bauwens, *Low Mach number analysis of idealized thermoacoustic engines with numerical solution.* Journal of the Acoustical Society of America, 2010. **128** (6): pp.3438-3448.

A15.   Hireche, O., C. Weisman, D. Baltean, P. Le Quéré, M.X. François, and L. Bauwens, *Numerical model of a thermoacoustic engine.* Comptes Rendus Mecanique, 2010. **338** (1): pp.18-23.

A16.   Kahouadji, L., B.C. Houchens, and L. Martin Witkowski, *Thermocapillary instabilities in a laterally heated liquid bridge with end wall rotation.* Physics of Fluids, 2011. **23** (10): pp.104104_1-104104_16.

A17.   Kahouadji, L., L. Martin Witkowski, and P. Le Quéré, *Seuils de stabilité pour un écoulement à surface libre engendré dans une cavité cylindrique tournante à petit rapport de forme.* Mécanique & Industries, 2010. **11** (5): pp.339-344.

A18.   Mehrez, Z., M. Bouterra, A. El Cafsi, A. Belghith, and P. Le Quéré, *Mass transfer control of a backward facing step flow by local forcing effect of Reynolds number.* Thermal Science, 2011. **15** (2): pp.367-378.

A19.   Navarro, M.C., L. Martin Witkowski, L. Tuckerman, and P. Le Quéré, *Building a reduced model for nonlinear dynamics in Rayleigh-Bénard convection with counter-rotating disks.* Physical Review E, 2010. **81** (3): pp.036323_1-036323_12.

A20.   Nore, C., J. Léorat, J.-L. Guermond, and F. Luddens, *Nonlinear dynamo action in a precessing cylindrical container.* Physical Review E, 2011. **84** (1): pp.016317_1-016317_7.

A21.   Patricio, P., N.M. Silvestre, C.-T. Pham, and J. Roméro-Enrique, *Filling and wetting transitions of nematic liquid crystals on sinusoidal substrates.* Physical Review E, 2011. **84**: pp.021701_1-021701_8.

A22.   Pham, C.-T., G. Berteloot, F. Lequeux, and L. Limat, *Dynamics of complete wetting liquid under evaporation (inclus Erratum 2011).* Europhysics Letters, 2010. **92**: pp.54005_1-54005_5.

A23.   Roméro-Enrique, J., C.-T. Pham, and P. Patricio, *Scaling of the elastic contribution to the surface free energy of a nematic liquid crystal on a sawtoothed substrate.* Physical Review E, 2010. **82** (1): pp.011707_1-011707_7.

A24.   Trouette, B., E. Chénier, C. Dang Vu, and B. Guerrier, *Numerical study of convection induced by evaporation in cylindrical geometry.* European Physical Journal Special Topics IMA5 - Interfacial Fluid Dynamics and Processes, 2011. **192**: pp.83-94.

A25.   Trouette, B., C. Dang Vu, and G. Labrosse, *About the ellipticity of the Chebyshev-Gauss-Radau discrete Laplacian with Neumann condition.* Journal of Computational Physics, 2010. **229** (19): pp.7277-7286.

Books & chapters in books

B1.   Dang Vu, C., *Chaos et catastrophes dans les systèmes dynamiques*, in *Techniques de l'Ingénieur : Mathématiques pour l'ingénieur*, T. Carrere, Editor. 2010, Techniques de l'Ingénieur. pp. 1405_1-1405_20.

B2.   Dang Vu, C. and D. Schwabe, *The European physical journal - Special Topics : IMA 5 interfacial fluid dynamics and processes* 2011: EDP Sciences.

B3.   Sergent, A. and P. Le Quéré, *Large-scale patterns in a rectangular Rayleigh-Benard cell*, in *Direct and Large-Eddy Simulation VII, ERCOFTAC Series, Vol. 13*, V. Armenio, B. Geurts, and J. Frohlich, Eds. 2010, Springer. pp. 425-428.

Conferences with proceedings and review committee

C1.   Brethouwer, G., Y. Duguet, and P. Schlatter. *Turbulent-laminar coexistence in stratified open channel flow*. in *International Symposium on Stratified Flows*. 2011. Roma, Italy. 1-8.

C2.   Chénier, E., C. Desceliers, C. Dang Vu, B. Trouette, F. Doumenc, and B. Guerrier. *Sensitivity of diffusive-convective transition to the initial conditions in a transient Bénard-Marangoni problem*. in *International Heat Transfer Conference*. 2010. Washington, USA. 6p.

C3.   Daru, V., D. Baltean, G. Gandikota, and C. Weisman. *Etude numérique du vent acoustique non linéaire dans un résonateur à ondes stationnaires*. in *Congrès Français de Mécanique*. 2011. Besançon, France. 1190_1-1190_6.

C4.   Delbende, I., M. Rossi, and B. Piton. *DNS of helical vortices*. in *Symposium on Applied Aerodynamics*. 2011. Orléans, France. 8p.

C5.   Duguet, Y., L. Brandt, and B.R.J. Larsson. *Perturbations non-linéaires optimales dans un écoulement de Couette plan*. in *Rencontre du Non-Linéaire*. 2010. Paris, France. 61-66.

C6.   Duguet, Y. and P. Schlatter. *Stochastic motion of a laminar/turbulent interface in a shear flow*. in *EUROMECH European Turbulence Conference*. 2011. Warsaw, Poland: IOP. 032026_1-032026_7.

C7.   Duguet, Y. and P. Schlatter. *Stochastic evolution of a turbulent interface in a shear flow*. in *Rencontre du Non-Linéaire*. 2011. Paris, France. 57-62.

C8.   Le Quéré, P. *On the computation of some external or partially enclosed natural convection flows*. in *International Conference on Computational Heat and Mass Transfer*. 2011. Istanbul, Turquie. 401_1-401_8.

C9.   Leplat, G., Y. Fraigneau, P. Le Quéré, P. Reulet, and P. Millan. *Experimental and 3D numerical investigation of buoyancy-driven instabilities around a heated horizontal square cylinder within an enclosure*. in *International Heat Transfer Conference*. 2010. Washington, USA. 6p.

C10. Leplat, G., Y. Fraigneau, P. Reulet, and P. Le Quéré. *Etude expérimentale et numérique 3D des instabilités de convection naturelle générées autour d'un barreau carré chauffé positionné horizontalement au centre d'une cavité*. in *Congrès Français de Thermique*. 2010. Le Touquet, France: Société Française de Thermique. 227-232.

C11. Luddens, F., C. Nore, J. Léorat, J.-L. Guermond, and A. Ribeiro. *Equations de la MHD en milieu hétérogène*. in *Congrès Français de Mécanique*. 2011. Besançon, France. 183_1-183_6.

C12. Nore, C., J. Léorat, J.-L. Guermond, and F. Luddens. *Nonlinear dynamo action in a cylindrical container driven by precession*. in *EUROMECH European Turbulence Conference*. 2011. Warsaw, Poland: IOP. 072034_1-072034_3.

C13. Piton, B., I. Delbende, and M. Rossi. *Simulations numériques de vortex à symétrie hélicoïdale*. in *Congrès Français de Mécanique*. 2011. Besançon, France. 6p.

C14. Podvin, B. and P. Le Quéré. *Etude d'un canal stratifié différentiellement chauffé*. in *Rencontre du Non-Linéaire*. 2011. Paris, France. 133-138.

C15. Sergent, A., Z. Gao, B. Podvin, S. Xin, and P. Le Quéré. *Simulation de l'écoulement dans un canal différentiellement chauffé*. in *Congrès Français de Mécanique*. 2011. Besançon, France. 286_1-286_6.

C16. Sergent, A. and P. Le Quéré. *Long time evolution of large-scale patterns in a rectangular Rayleigh-Bénard cell*. in *EUROMECH European Turbulence Conference*. 2011. Warsaw, Poland: IOP. 082010_1-082010_7.

C17. Weisman, C., D. Baltean, P. Le Quéré, and L. Bauwens. *Modèle faible Mach et simulations numériques 2D de l'amplification d'onde thermoacoustique*. in *Congrès Français d'Acoustique*. 2010. Lyon, France. 6p.

C18. Weisman, C., D. Baltean, P. Le Quéré, and L. Bauwens. *Numerical study of thermoacoustic wave amplification*. in *European Conference on Computational Fluid Dynamics*. 2010. Lisbon, Portugal. 9p.

C19. Weisman, C., D. Baltean, P. Le Quéré, and L. Bauwens. *Comparison of different heat exchanger models in a thermoacoustic engine simulation*. in *Joint US-European Fluids Engineering Summer Meeting and 8th International Conference on Nanochannels, Microchannels, and Minichannels*. 2010. Montreal, Canada. 8p.

C20. Weisman, C., D. Baltean, P. Le Quéré, and L. Bauwens. *Modélisation nonlinéaire des écoulements et transferts de la cellule active d'un moteur thermoacoustique*. in *Congrès Français de Mécanique*. 2011. Besançon, France. 669_1-669_6.

C21. Xin, S., J. Chergui, L. Hu, and P. Le Quéré. *Coupling of turbulent 3D natural convection flow with surface radiation in air-filled cavity*. in *International Conference on Computational Heat and Mass Transfer*. 2011. Istanbul, Turquie. 349_1-349_6.

Conferences without proceedings, workshops

D1.   Brethouwer, G. and Y. Duguet. *Numerical study of turbulent-laminar patterns in MHD, rotating and*

stratified shear flows. in *8th Direct and Large Eddy Simulation Workshop, DLES8*. 2010: ERCOFTAC. 2p.

D2.   Brethouwer, G., Y. Duguet, P. Schlatter, and D. Henningson. *Laminar-turbulent patterns in rotating plane Couette flow*. in *Euromech Colloquium 525*. 2011. Ecully, France.

D3.   Delbende, I., M. Rossi, and B. Piton. *Direct numerical simulation of vortices with helical symmetry*. in *European Fluid Mechanics Conference*. 2010. Bad Reichenhall, Germany.

D4.   Delbende, I., M. Rossi, and B. Piton. *Dynamics of flows with helical symmetry*. in *International Symposium Bifurcations and Instabilities in Fluid Dynamics*. 2011. Barcelona, Spain.

D5.   Duguet, Y., G. Brethouwer, P. Schlatter, and D. Henningson. *Spatio-temporal intermittency in plane Couette flow*. in *European Fluid Mechanics Conference*. 2010. Bad Reichenhall, Germany.

D6.   Duguet, Y., O. Le Maitre, and P. Schlatter. *Front velocities in plane Couette flow*. in *Annual Meeting of the APS Division of Fluid Dynamics*. 2011. Baltimore, USA.

D7.   Duguet, Y., P. Schlatter, D. Henningson, and B. Eckhardt. *Edge states in boundary layer flows*. in *International Symposium Bifurcations and Instabilities in Fluid Dynamics*. 2011. Barcelona, Spain.

D8.   Duguet, Y., P. Schlatter, D. Henningson, B. Eckhardt, A. Willis, and R. Kerswell. *Edge states and turbulence spreading in subcritical shear flows*. in *Ercoftac SIG 33 Workshop*. 2010. Nice, France.

D9.   Kahouadji, L., L. Martin Witkowski, and P. Le Quéré. *Stability threshold for the flow driven by a rotating disk in a small aspect ratio open cylindrical cavity*. in *Conference of the International Marangoni Association, Interfacial Fluid Dynamics and Processes*. 2010. Florence, Italy.

D10.   Kahouadji, L., L. Martin Witkowski, N. Peres, S. Poncet, P. Le Quéré, and E. Serre. *Primary bifurcation of a thin-layer flow driven by a rotating disk in a fixed open cylindrical cavity: flat free surface*. in *International Symposium Bifurcations and Instabilities in Fluid Dynamics*. 2011. Barcelona, Spain.

D11.   Nore, C. *Dynamo action in finite cylinders*. in *Euromech Colloquium 525*. 2011. Ecully, France.

D12.   Nore, C. *Dynamo action in a precessing cylinder*. in *International Symposium Bifurcations and Instabilities in Fluid Dynamics*. 2011. Barcelona, Spain.

D13.   Pham, C.-T., G. Berteloot, F. Lequeux, and L. Limat. *Dynamics of complete wetting liquid under evaporation*. in *MULTIFLOW Conference 2010*. 2010. Brussels, Belgium.

D14.   Pham, C.-T., G. Berteloot, F. Lequeux, and L. Limat. *Dynamics of a complete wetting liquid under evaporation*. in *European Coating Symposium*. 2011. Turku, Finland.

D15.   Podvin, B. and P. Le Quéré. *Convection between two differentially heated vertical plates with stratification*. in *International Symposium Bifurcations and Instabilities in Fluid Dynamics*. 2011. Barcelona, Spain.

D16.   Rossi, M., I. Delbende, and B. Piton. *Dynamics of flows with helical symmetry*. in *Euromech Colloquium 525*. 2011. Ecully, France.

D17.   Sergent, A. *Large eddy simulations of large-scale patterns in a rectangular Rayleigh-Bénard cell*. in *High Ra Convection Euromech Colloquium 520*. 2010: EUROMECH.

D18.   Sergent, A., S. Xin, P. Joubert, P. Le Quéré, J. Salat, and F. Penot. *Vers une stratification thermique cohérente avec l'expérimentation : cas de la convection naturelle turbulente en cavité différentiellement chauffée*. in *Congrès Français de Mécanique*. 2011. Besançon.

D19.   Trouette, B., C. Dang Vu, E. Chénier, and B. Guerrier. *Numerical study of convection induced by evaporation in cylindrical geometry*. in *Conference of the International Marangoni Association, Interfacial Fluid Dynamics and Processes*. 2010. Florence, Italy.

D20.   Xin, S. and P. Le Quéré. *Stability of 2D Natural Convection Flows in Differentially Heated Cavities: 2D/3D Disturbances*. in *International Symposium Bifurcations and Instabilities in Fluid Dynamics*. 2011. Barcelona, Spain.

MICHEL PONS

Introduction

The specificity of the *Solid-Fluid Transfer group* doubtlessly lies in *Heat transfer* and *Energetics*. Another characteristic is that practically all of its members are or were experimentalists; if not, they closely work (or worked) with experimentalists. We are not specialists in numerical techniques; we are rather users of numerical codes. We use, sometimes we develop, numerical codes with the intention of correctly simulating and finely understanding the basic phenomena involved in complex or innovative transfer problems. Beyond that, we often have in mind the purpose of improving the efficiency of a transfer process, *e.g.* intensification of heat-transfer, separation, or energetic efficiency.

Heat transfer and *Energetics* are constantly revisited by new experimental techniques, such as optical velocimetry, new materials, or new challenges (micro- and nano-scales). The field is broad, and the *Solid-Fluid Transfer group* explores four domains: (i) two-phase flows, (ii) oscillating flows, (iii) heat transfer from solid to superfluid helium, and (iv) applications of convective transfers. Scientific results obtained in each theme are described further on; they also correspond to specific skills that we have developed. Globally speaking, these skills are, first, experimental, second, numerical:

- *Particle Image* Velocimetry, Laser Doppler Velocimetry, Piezoelectric pressure sensors, for studying acoustic streaming of various intensity in thermoacoustic / acoustic resonators;
- Hot wires in an oscillating fluid, for cases where optical velocimetry techniques cannot be used;
- Thermal probes (temperature, fluxes) in cryogenics conditions, for studying the Kapitza resistance at cryogenic temperatures;
- Parallel computing of divergence-free two-phase flows with front-tracking, for studying Faraday waves and their extensions;
- Computing of flows at Low-Mach-number with front-tracking, for two-phase flows at the microscale;
- Asymptotic expansions, perturbation methods, for microfluidic suspensions;
- Computing of divergence-free flows in open domains, for natural convection in buildings;
- Second law analyses, especially *of solar-powered processes*, for Solar Refrigeration and more.

Because they are related to thermal- or energy-engineering, the issues addressed in the *Solid-Fluid Transfer group* often build bridges between theoretical investigations and applications. These applications range from nano-science and micro-fluidics to solar air-conditioning, superconducting cavities of particle accelerators, and emergency-cooling of nuclear reactors.

The SFT group is specific but not isolated. The skills listed above are often developed with the precious help of other people in the Mechanical-Engineering Department, namely F. Lusseyran (AERO group) for PIV and LDV techniques, J. Chergui (CIGITA) for parallelization of numerical codes with front-tracking or with thermal problems, V. Daru (AERO group) for numerical simulation of two-phase flows and for acoustic streaming in a resonator, Y. Fraigneau (CIGITA) for implementing pressure-driven boundary conditions on open domains, C. Weisman (CORO group) for numerical simulations where a thermoacoustic cell is coupled to a resonator.

We collaborate with various French laboratories or institutions (IPNO, PMMH, CEA/IRFU, CEA/LITEN, Pprime, EM2C, LAUM, PIMENT, IEF, LGEP, LadHyX…) and we participate in some research networks: GdR *Thermoacoustique*, GdRe *Thermal Nanosciences and Nanoengineering*, and the Research Federation *TM&C* (Heat and Mass Transfer in the Ile-de-France region). Our international collaborators are Hongik Univ. (South Korea), ETH (Zürich, Switzerland), Univ. Calgary (Canada), Univ. Oran (Algeria), Univ. Marrakech (Morocco), École Polytechnique Tunisie, IPPT in Acad. Sci. and Univ. Warsaw (Warsaw, Poland), Zhukovsky Inst. and Inst. Phys. Chem. and Electrochem. Russian Acad. Sci. (Moscow, Russia), Tech. Inst. Phys. Chem. Beijing, Inst. Refrig. and Cryog. Zhejiang Univ., Hangzhou (China), and MIT (USA).

Research presentation

Topic 1: Two-phase flows: dynamics and transfers

M.-C. Duluc, D. Juric, *F. Feuillebois, N. Périnet, G. Prigent, L. Kahouadji with contributions of V. Daru (AERO), J. Chergui (CIGITA), P. Le Quéré (CORO)*

In the broad field of two-phase flows, LIMSI is distinct in its experience in numerical techniques for simulating the dynamics of interfaces. The techniques used depend on the case under consideration. For suspensions of particles, droplets or bubbles, the characteristic length of the interface is much smaller than that of the fluid flow. In such conditions, the shape of the interface hardly changes, and drops or incompressible bubbles can be treated like particles. In addition, microscale situations make inertial effects much less preeminent. For this first set of phenomena, analytical or asymptotic methods can be used. At usual scales, the fluid and the interface have similar sizes, and the interface can take special shapes, for instance in *Faraday waves*. This phenomenon is very interesting theoretically while being useful for checking the validity of our numerical schemes by comparing our results to experimental data. For this problem, as well as the following, we follow the evolution of the interface shape with the *Front-tracking* technique, preferred to other ones (VOF, level set) for the sake of accuracy. In the latter case, the gas phase density is constant and uniform. A significant effort was made in these last years in parallelizing the numerical code, a task achieved with the significant contribution of J. Chergui (CIGITA). Further on, LIMSI's long term goal is still to accurately simulate liquid-vapor flows involving phase change, heat transfer and convection. Bubble growth by evaporation, detachment, and possible shrinkage is a typical example. Dynamics of vapor bubbles in microscale geometries with the possibility of evaporation or condensation are other examples. In such cases, the effects of gas-phase compressibility must be taken into account. Using the *Low Mach number* approach, compressibility effects were included in our numerical codes while still ensuring mass conservation. There is still much to do, for instance describing the dynamics of the contact line with solid surfaces when relevant, or heat & mass transfer in the presence of phase change.

Suspensions and droplets

Solid suspensions in micro-scale flows are studied in collaboration with PMMH, LadHyX, École Polytechnique de Tunisie, IPPT at the Polish Academy of Science (Warsaw, Poland), Univ. Warsaw (Poland), Zhukovsky Inst. (Moscow region, Russia), Inst. Physical Chemistry and Electrochemistry at the Russian Academy of Science (Moscow), and MIT (USA). At micro-scales, the Reynolds number Re is low compared to one and hydrodynamic interactions with walls play a prominent role in the dynamics of solid suspensions. Small fluid inertial effects (of the order of Re^2) produce differential lift forces on particles, thus inducing particle separation. Those forces can be derived by a perturbation method. For a particle in a shear flow close to a wall, the perturbation problem is regular; the lift force on a spherical particle contains various coupling terms which are used for modeling separation processes (Yahiaoui and Feuillebois, 2010). For two particles in an unbounded shear flow, the singular perturbation problem is solved by matching asymptotic expansions. The flow fields, and the resulting particle velocities, depend on the relative positions of the two wakes (Asmolov and Feuillebois, 2010). Solutions in creeping flow (of the order of Re) have been found for various combinations of walls and particles. The case of spherical particles in Poiseuille flow along solid plane walls was solved with an analytical method, see Fig. 1, and results were exploited for optimizing separation techniques in analytical chemistry (Pasol *et al.*, 2011).

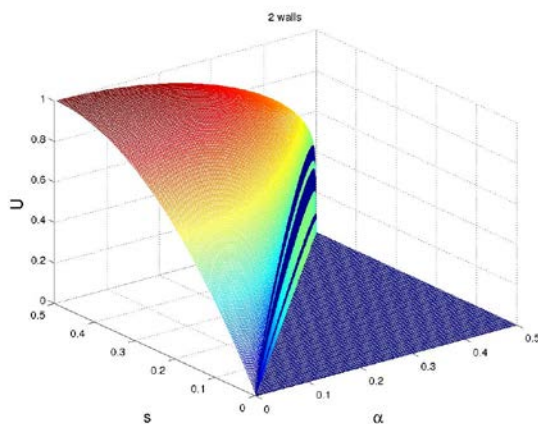*Figure 1: Velocity of a freely moving sphere entrained in a Poiseuille flow, normalized by the maximum Poiseuille flow velocity, versus the dimensionless sphere radius α and the dimensionless sphere center position s. The creeping flow (Stokes) equations were solved by the accurate multipole method (Pasol et al., 2011).*

From that case on, particle and walls shapes were made more and more complex, from ellipsoids

settling in a cubic container -solved by the boundary integral method (Hedhili *et al. CMES*, 2011)- up to spherocylinders (trunk of a cylinder and two hemispherical caps) as used in biological applications. By modeling the spherocylinder as an assembly of interpenetrating spheres and using the multipole method, an excellent agreement with experiments could be obtained (Mongruel *et al.*, 2011). When the walls are porous (with pores much smaller than the particles), the difficulty lies in the boundary conditions between the fluid and the porous wall, where the Stokes and Darcy equations apply respectively. A first approach, based on singularities in Stokes flow close to a porous membrane, is the method of fundamental solution where singularities are located outside of the flow field. First, no-slip conditions were assumed along the porous wall (Debbech *et al.*, 2010). Then, the more elaborate Beavers and Joseph slip-conditions were used in various other works. The case of particles in a viscous flow near a porous wall was treated, first by a perturbation method developed at fourth order with respect to the ratio $D_{pore}/D_{particle}$ (Khabthani *et al.*, 2011), then with a peculiar semi-analytical boundary integral technique adapted to the slip boundary condition on the porous wall, while the special case of one spherical particle was solved analytically by the method of bi-spherical coordinates (Feuillebois *et al.*, AIP Proc., 2011). Hydrophobic or super-hydrophobic walls, well-represented by slip conditions, can be used for inducing mixing with microscale flows. F. Feuillebois rigorously proved that the wall textures can be optimized in order to maximize the cross-flow in the spanwise direction and thus the mixing effect (Feuillebois *et al. Phys. Rev. E* 2010).

Droplets, their dynamics and thermal effects, are important in nuclear engineering: in the case of a severe accident, Pressurized Water Reactors are sprayed with water. We studied how the water droplets coalesce during their fall from the injection nozzles located at the top of the containment vessel. Various collision regimes of two drops, as measured at IRSN (Saclay), are well correlated with a new "symmetric Weber number" (Rabe et al 2010). Droplets are also important in aircraft engineering: icing of aircrafts due to impinging supercooled water drops is likely to cause severe accidents. The freezing of a supercooled drop in an airflow was calculated with the method of matched asymptotic expansions with respect to the small Stefan number (Tabakova *et al.*, 2010). When a liquid drop hits a dry solid surface, an axisymmetrical jet is ejected from the wall. The shape and dynamics of such jets were calculated by solving the unsteady boundary layer at second order, accounting for the presence of the free surface (Tabakova *et al.*, 2011). The results agree well with recent experimental observations performed by the same authors, using rapid video pictures of drops in icing wind tunnels (Mongruel *et al.*, 2011).

Large scale liquid-gas interface with incompressible gas phase

One specificity of LIMSI's numerical work on two-phase flows is the *Front-tracking* technique which we exploit in two types of configuration, distinguished by the compressibility of the gas phase.

When a container containing two immiscible fluids (*e.g* water and air) is periodically shaken in the vertical direction, beyond a certain threshold the interface forms many kinds of standing-wave patterns, from crystalline to much more complex patterns. This phenomenon, discovered by Faraday in 1831, is called *Faraday waves*. It is an archetypical phenomenon endowed with a great fundamental interest for understanding the natural formation of patterns. Due to the nonlinearity of the problem, one needs a nonlinear hydrodynamic code for answering basic theoretical questions such as the conditions under which the instability is subcritical or supercritical. Moreover numerical simulation provides detailed information about the interface position and velocity field. A less widely exploited advantage of numerical simulations is that they can go beyond experiment: initial conditions can be precisely specified; symmetries such as two-dimensionality or hexagons can be imposed, perturbations can be rendered formally infinitesimal, unstable states can be computed. D. Juric and J. Chergui (CIGITA LIMSI), in collaboration with L. Tuckerman (PMMH-ESPCI, Paris) and N. Périnet (currently post-doc at UOIT, Canada), achieved three-dimensional numerical simulations of the full flow field (Périnet *et al.*, *JFM*, 2009). This work opened a long range study of the dynamics of free surfaces. Indeed, *Faraday wave* experiments conducted in the 1990's produced unexpected phenomena such as quasi-crystals, superlattices and oscillons. The comprehension of these more exotic Faraday scenarios requires numerical studies. This is why a new high-performance, parallel computer code is under development in our group in collaboration with S. Shin (Hongik Univ., South Korea), for the simulation of two-phase incompressible flows. The code combines our latest algorithms for Lagrangian tracking of arbitrarily deformable phase interfaces including breakup and coalescence and an improved treatment of surface tension forces, interface advection and mass conservation. This first implementation (to our knowledge) of front-tracking on large-scale parallel architectures has been successfully run on up to 8192 processors on the IBM BlueGene machine at IDRIS with excellent scalability performance as shown in Figure 2. A wide variety of incompressible two-phase phenomena (instabilities, coalescence and breakup, impacts, etc.) can now be simulated on large or complex spatial domains. For instance, recent experiments by J. Rajchenbach (Univ. Nice) of highly dynamic Faraday waves show five-petaled localized patterns which

have never been observed previously. Our new code has been able to simulate these highly nonlinear regimes and reproduce the experimental pentagonal pattern, see Figure 3. Another set of Faraday experiments, conducted by Y. Couder's group (Univ. Paris-Diderot), demonstrates exotic petal like patterns on the surface of a rotating vibrated liquid surface. Work with L. Kahouadji (LIMSI) and L. Tuckerman is aimed at characterizing the instability threshold of this rotating Faraday experiment.
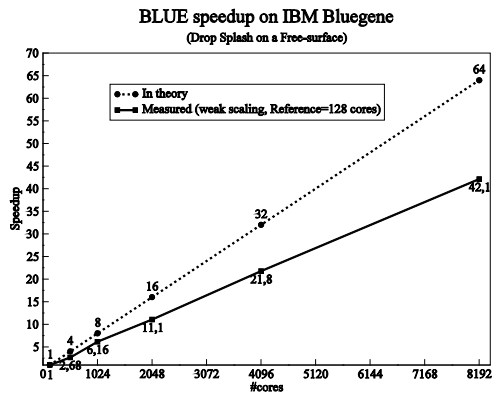
Figure 2 - Performance increase with number of cores
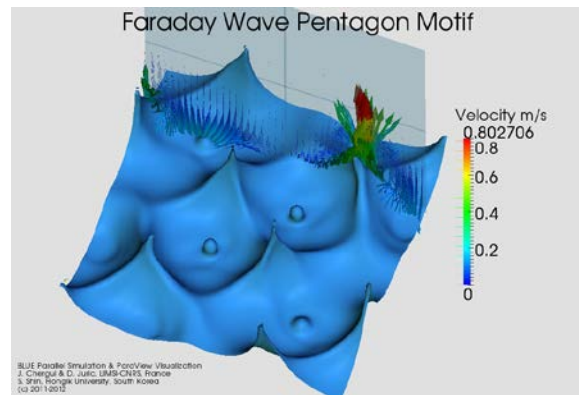
Figure 3 - Calculated five-fold pattern

Our program on the study of the dynamics of free surfaces, films and general fluid-fluid interfaces can find applications in domains ranging from micro-fluidics for biochips (micro-encapsulation) to marine engineering (hull drag reduction by bubble injection).

Microfluidics with a compressible gas phase

Two-phase flows involving phase change cannot be completely simulated without accounting for the compressible nature and the equation of state of the gas phase. Strictly speaking, the time-step for simulating compressible flows should be short enough for representing acoustic waves. However, a wide range of two-phase flows are controlled by heat transfer rather than by pressure waves; fluid velocity is then much smaller than sound velocity, a feature that allows the use of the *Low Mach number* approximation and thus to significantly accelerate numerical simulations. A significant effort was made in these last years for developing numerical schemes adapted to two-phase flows where the gas phase is characterized by a low Mach number. The liquid phase is treated as incompressible, *i.e.* with a divergence-free flow. The concept is valid, as demonstrated by 1D test-cases involving liquid-vapor phase change and fast interface dynamics[9]. However, when simulating 2D or 3D configurations two bottlenecks arise. First, one has to correlate the pressure field in the liquid phase, which is defined up to an additive constant, to the thermodynamic pressure in the gas phase. Second, mass is not exactly preserved by the front-tracking algorithm when the flow is divergence-free on one side only of the interface. We are currently developing algorithms, hopefully robust and rapid, for solving those two problems. The first one is studied by considering several gas bubbles, with different values of gas pressure, embedded in a liquid not submitted to gravity. As the gas pressure takes different values from one bubble to the next, the forces exerted by the bubbles on the liquid phase generate motion, and the fluid inertia induces alternate expansions and contractions of the bubbles. V. Daru (AERO group) solved the problem by introducing a third pressure field in the algorithm, called the *extended field*, that insures continuity of the total pressure field (Fig. 4). The three pressure fields have comparable orders of magnitude. Validation shows that this method is much more efficient than those based on a single pressure field (Daru *et al.*, *JCP*, 2010).

For the second problem (mass conservation in the vicinity of the interface, a crucial point), recent progress has been made by G. Prigent, PhD student. After rigorous verification of each step of the numerical scheme, we decided to combine the front-tracking technique with a sharp stepwise Heaviside function; discrepancies in the mass and energy balances were reduced down to acceptable values. A new test-case at low velocity has been elaborated for that delicate issue, where a gaseous bubble is transported by liquid across a non-isothermal micro-channel, see Fig. 5. The first results are encouraging (Prigent et al., 2012). Configurations with higher velocities are being currently tested.

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[9] V. Daru, M.-C. Duluc, O. Le Maître, D. Juric and P. Le Quéré, Modélisation et simulation numérique du changement de phase liquide-vapeur en cavité, *Comptes Rendus de Mécanique*, **334** (2006), pp. 25-33.
M.-C. Duluc, O. Le Maître, V. Daru and P. Le Quéré, Oscillations of a liquid inclusion inside a closed cavity filled up with gas and externally heated, *Microfluidics and Nanofluidics*, **6** (2009), pp. 163-177.

It can be seen that any new version of our numerical codes is validated by comparison with either (i) analytical solutions, (ii) numerical solutions given by other physically relevant models, (iii) data derived from linear stability analyses, or (iv) experimental data when possible. This rigorous approach requires significant effort, but we meanwhile elaborate original test-cases that can be helpful as benchmarks proposed to the two-phase flow community.

Figure 4 - Velocity and hydrodynamic pressure fields for six air bubbles immersed in liquid water inside a closed cavity: as different thermodynamic pressures are set for the bubbles, oscillations are observed.
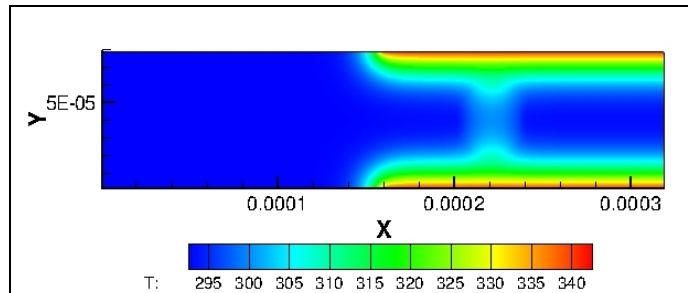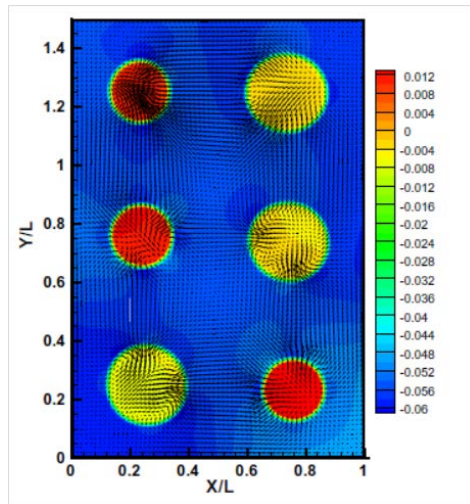
Figure 5 - Alteration of the temperature field occurring when an air bubble is transported by water through a micro-channel partially adiabatic (left side) and partially heated (right side). Thermal diffusivity is larger in air than in water.

Topic 2: Oscillating flows: dynamics and transfers

D. Băltean-Carlès, S. Kouidri, *G. Defresne, F. Jebali, R. Paridaens, Ph. Debesse, with contributions of V. Daru (AERO), F. Lusseyran (AERO) and C. Weisman (CORO)*

This theme is closely related to that of the Transverse Action *Thermoacoustics-Cryogenics*, with the following difference however. In LIMSI, a *transverse* research activity involves people of different groups. Two numerical programs related to thermoacoustics fulfill this condition; both involve the *Solid-Fluid Transfer* group (D. Baltean-Carlès, and recently M. Pons), one with V. Daru (AERO group), and the other one with C. Weisman (CORO group). Although these programs are presented in two groups (the former here-under, the latter in the CORO group) collaboration is active, as shown by the articles jointly published.

Like many other laboratories involved in thermoacoustics, LIMSI focuses on experimental investigation of acoustic streaming. Acoustic streaming is the generic name of flows at low velocity (one order of magnitude less than the acoustic velocity, therefore also called secondary flows) generated within acoustic waves developed in configurations such as thermoacoustic stacks, acoustic loops of Stirling-type thermoacoustic machines, or simple resonator tubes (3D geometry with no-slip conditions at the wall). Those secondary flows do not need to consume much acoustic energy, but they induce transport of enthalpy which are very detrimental to thermoacoustic conversion of energy, and thus justify serious study.

With the precious help of F. Lusseyran (AERO group), several experimental techniques have been developed in the *Solid-Fluid Transfer* group: (i) characterization of the pressure field related to the secondary flow; (ii) characterization of the velocity field by Particle Image Velocimetry (PIV) or (iii) by Laser Doppler Velocimetry (LDV).

The pressure profile generated in our thermoacoustic prime mover of the Stirling type (progressive wave), cf. Fig. 6, is measured with piezoelectric sensors. Interpretation of experimental data requires the acoustic field to be known. We model it with a linear model, and obtain differences with the experimental data lower than 10%, see Fig. 7 (Kouidri *et al.*, CFA 2010, ASME-ATI-UIT 2010 ; Paridaens *et al.* CFM 2011, ASME 2011). The so-characterized secondary pressure field shows that the acoustic streaming of that engine is of the *slow-type* (*linear* regime). Moreover, we derived deviations from the linear acoustic model, showing that acoustic streaming is generated by interactions between (i) the axial acoustic velocity and (ii) the acoustic parts of density, radial velocity, and temperature respectively.
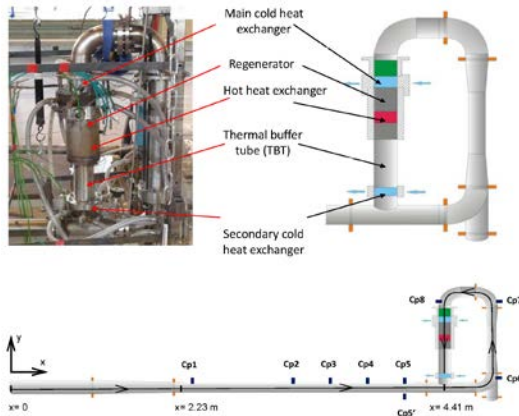
Figure 6 - Thermoacoustic prime mover of the Stirling type: 4.25 m long, working frequency of 22Hz, operated with nitrogen up to 25 bars.
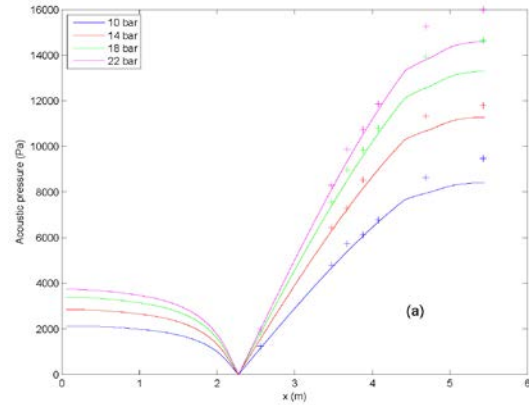
Figure 7 - Experimental and numerical values of the acoustic part of the pressure field along the resonator and loop for various mean pressures.

However, velocity measurements are crucial for characterizing those secondary flows. The first technique developed in the *Solid-Fluid Transfer* group has been PIV. The PIV cell is implemented on a standing wave resonator, where the wave is generated by a thermoacoustic engine (a stack plus two heat exchangers) operated like a real machine (mean pressure above 7 bars and large wave amplitude). The PIV cell occupies only a small volume of the resonator. Here again, capturing the second order velocity field corresponding to the streaming flow ($\sim$1 cm.s^{-1}) requires a very accurate evaluation of the first order acoustic velocity field ($\sim$1 m.s^{-1}). A general post-processing method has thus been developed for handling under-resolved sampling recorded on long time scales[10]. The theory of linear acoustics can be applied when both drive-ratio and rate of harmonics in the PIV cell are small. However, for higher drive-ratios, the rate of harmonics becomes significant and creates strong dissymmetry between velocity extrema, meaning that the harmonics are not in-phase with the fundamental wave. We observe such dissymmetry (see Fig 8). The secondary flow we visualize is unsteady, with more streaming cells than in the usual Rayleigh streaming (see Fig. 9). Nonlinear effects related to inertia are probably responsible for that behavior, an assumption that could be validated later on by changing the position of the PIV cell along the resonator.
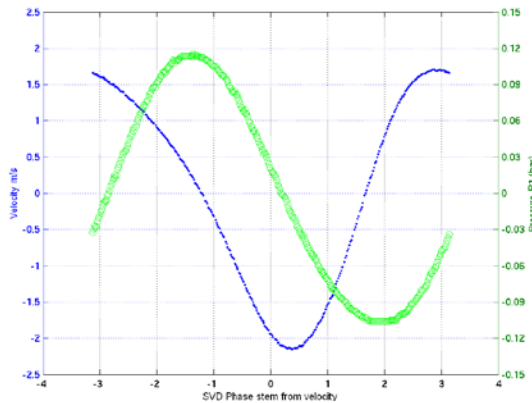
Figure 8 - axial velocity (in blue dots) and acoustic pressure (in green circles) over one acoustic period.
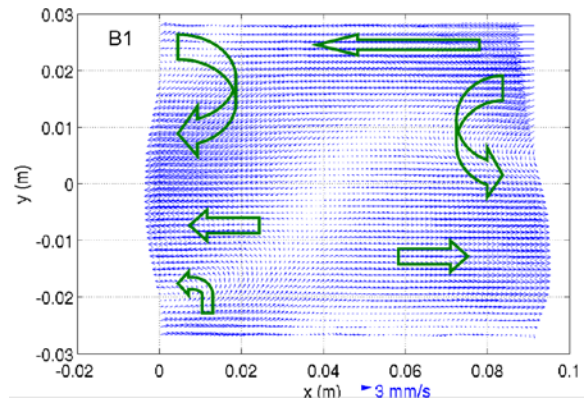
Figure 9 - Average secondary velocity field in the symmetry plane of the PIV cell.

The *Solid-Fluid Transfer* group also develops the LDV technique, again for measuring the acoustic streaming in resonators. For this purpose, the LDV technique seems to be more reliable than the previously developed hot-wire technique. Our experimental frequency spectra display rich harmonic cascades (see Fig. 10) a signature of highly nonlinear waves (as expected when generated by an acoustic source operated at 160dB). Secondary velocity is obtained after refined data interpretation, see Fig. 11. For that study we

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[10] P. Debesse, Vers une mesure du vent thermoacoustique, PhD Thesis UPMC/LIMSI, 5 décembre 2008.
P. Debesse, D. Baltean-Carles, F. Lusseyran, Experimental analysis of nonlinear phenomena in a thermoacoustic system, in *Nonlinear Acoustics, Fundamentals and Applications*, Proc. 18th ISNA, July 07-10, 2008, Stockholm Sweden, vol. 1022, 355-358, 2008.

collaborate with Pprime (Poitiers) in the framework of the GdR 3058 *Thermoacoustique* (Task *Investigation of streaming flows by laser metrology*), share our skills and compare our results on LDV measurements.
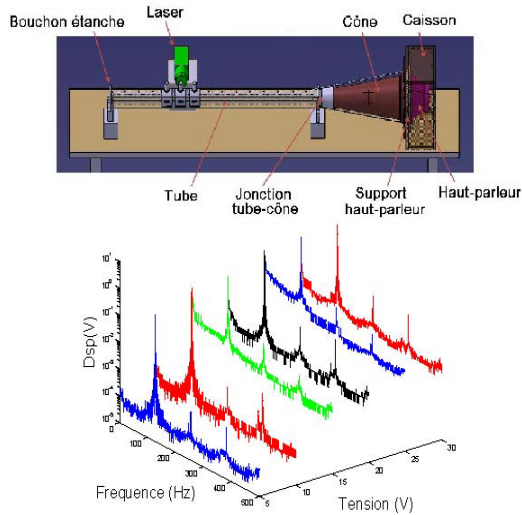
Figure 10 - Experimental set-up for the LDV measurements (top) and an example of measured spectra (bottom).
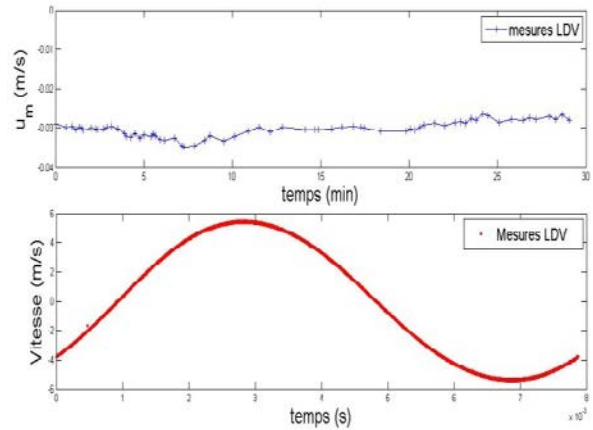
Figure 11 - Experimental values of axial velocity measured by LDV: secondary velocity of the order of cm.s^{-1} (top), acoustic velocity of the order of m.s^{-1} (bottom).

Our experimental investigations of acoustic streaming explore the nonlinear regime (also called *fast streaming*), where inertia of the fluid plays a significant role. The characteristic number is the nonlinear Reynolds number, Re_{NL} [$Re_{NL} = (M.R/\delta_v)^2$, where M is the Mach number, R the radius of the resonator and δ_v the thickness of the viscous boundary layer]. The literature devoted to the nonlinear regime is poor: some numerical studies report distorted streaming cells and symmetry breaking with apparition of additional streaming cells. However, the phenomenon itself and transition to the nonlinear regime still need to be analyzed. Among the advanced numerical methods developed at LIMSI, V. Daru (AERO group) has built a numerical code that solves the compressible Navier-Stokes equations with an explicit finite-difference scheme, upwind at the third order in time and space for the convective terms and centered at the second order for the diffusive terms (Daru et al. *CFM* 2011). This code is well-adapted for propagation of acoustic waves in compressible viscous fluids. The simulated resonator is 2D (Cartesian or axisymmetric). A standing wave is generated by imposing an axial volume force that is a sine function of time with prescribed frequency. The investigated values of Re_{NL} range from 0.001 to some tens (values as high as 40 were simulated). Averaging the solution over the fundamental acoustic period yields the streaming flow. When Re_{NL} increases, shocks are observed; this justifies the use of this high accuracy explicit compressible code. Meanwhile, the centers of the streaming cells move toward the resonator ends (see Figure 12a). The average temperature field (Figure 12b) evidences complex coupling between both acoustic and streaming flows, and heat transfer. The average temperature field, quasi 1D for low values of Re_{NL}, becomes 2D when Re_{NL} increases, a consequence of balance between conduction and heat advection through the acoustic streaming. Our results are in good qualitative agreement with several experimental observations, for instance those of H. Baillet (Pprime, Poitiers). As the experimental Re_{NL} may be as high as 100, comparison with experiments requires a model that fully accounts for the nonlinearities of the *fast* streaming flow. This is what our model does; our first results are thus very promising. The next developments will (i) add other nonlinear effects, such as temperature dependence of fluid conductivity and viscosity, (ii) explore various gases, *e.g.* with low Prandtl number, (iii) insert a stack within the resonator, (iv) extend the code in 3D (after parallelization).

(a)

(b)
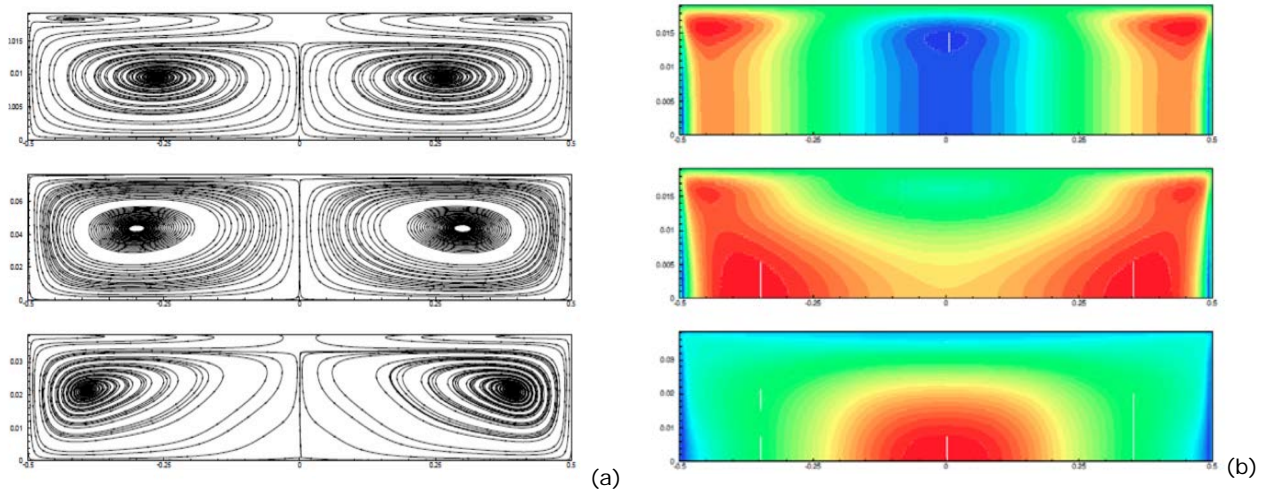
*Figure 12 – Calculated acoustic streaming flows in a Cartesian resonator filled with air
at atmospheric pressure (8.825mm long, upper half shown):
(a) streamlines and (b) average temperature field; from top to bottom Re_{NL}: 0.01, 8.25, and 13.26, resp.*

A simplified thermoacoustic engine was also analyzed (collab. C. Weisman, D. Baltean-Carlès, P. Le Quéré and L. Bauwens, University of Calgary), in which the active thermoacoustic cell is placed inside a long tube filled with the working gas at a given mean pressure, closed at one end and equipped with a load at the other end. The active cell consists of a stack of parallel conducting plates placed between two heat exchangers, also made of horizontal plates with a prescribed blockage ratio. The two-dimensional viscous and heat conducting flow model of the active thermoacoustic cell is properly coupled, through a small Mach number asymptotic analysis, with linear acoustics in the left and right parts of the tube. The resulting equations are solved numerically (O. Hireche Algerian Ph.D. thesis) using a 2D, time-dependent finite volume code, initially developed at LIMSI for non-Boussinesq natural convection flows. When a sufficiently large temperature difference is imposed between the heat exchangers, initial pressure perturbations are amplified, the fluid starts oscillating and amplitudes grow, up to the point when the engine reaches a stationary periodic operation. Transient flow and heat transfer are analyzed (K. Sodjavi's internship), as well as periodic operation (the fundamental frequency and the harmonic content is a simulation output). Results were compared with Rott's linear theory and with experimental results of existing prototypes. Comparisons and analyses are being pursued as part of L. Ma's Ph.D, which started in September 2011.
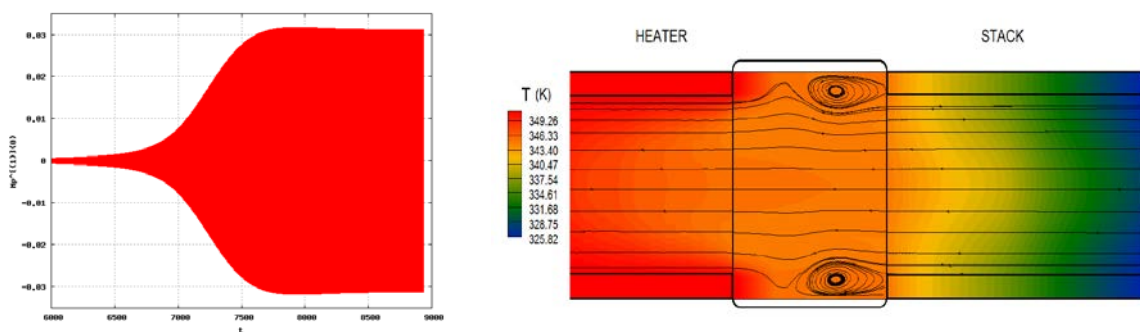
Amplification and saturation of a wave by thermoacoustic effect: Left: time history of acoustic pressure at active cell location. Right: detail snapshot: streamlines and temperature (color) between heater and stack

Topic 3: Heat transfer from solid to superfluid Helium

J. Amrit, *A. Ramière (PhD), R. Krishnan (Post-Doc)*

In the field of heat transfer at cryogenic interfaces, or in micro- / nano-structures, LIMSI addresses three issues in parallel, namely (i) the thermal *Kapitza* resistance at the interface between a Silicon crystal and

superfluid Helium, (ii) the thermo-magnetic stability of superconducting cavities designed for particle accelerators and (iii) the transport of heat in nanowires and in micro- or nano-junctions. The approach is mainly experimental, complemented with theoretical and numerical work. The physical underlying phenomenon is the scattering of phonons (which are the energy carriers) at interfaces and boundaries, and our purpose is to understand, analyze and predict the so-induced dissipation.

The thermal boundary *Kapitza* resistance is the phenomenon that produces a finite temperature jump at a solid-fluid interface at cryogenic temperatures. We succeeded in measuring the thermal boundary *Kapitza* resistance between Silicon and superfluid Helium at temperatures as low as 0.4K using a specially designed experimental cell. This pioneering result[11] was obtained in collaboration with J.-P. Thermeau and F. Chatelet (Institut de Physique Nucléaire d'Orsay). Also the contributions of ICMO and of LPS, Orsay, were very useful for characterizing the surface state by atomic force microscopy. Thanks to the highly polished surface of the single-crystal Silicon (111) the selective nature in heat transmission due to surface roughness at the nanoscale was substantiated. As a result, we could predict a transition in the transmission. This transition was observed and interpreted as a change from diffuse scattering to specular scattering when temperature decreases (Amrit, *Phys. Rev.*, 2010). More recently, we investigated the thermal boundary resistance as a function of the acoustic impedance (density x speed of sound) of superfluid Helium. Although the experimental pressure range (from standard vapor pressure –SVP- to 25 bars) corresponds to a change of 80% in the acoustic impedance, measurements show a change of only 7% in the thermal boundary resistance over the entire pressure range, see Fig. 13 (Ramière *et al.*, 2011, 2012). These results confirm that tailoring of interface transmission requires control of the interface roughness, Fig. 14-15. Current experiments explore the transition in the thermal boundary resistance at the Si/He interface upon solidification of superfluid Helium.

We study the thermal stability of superconducting particle accelerators in collaboration with C.-Z. Antoine (CEA/IRFU, Saclay). Our recent measurements of the thermal boundary resistance between Niobium single crystals and superfluid Helium helped designing novel superconducting cavities made of Niobium single crystals (Amrit and Antoine, 2010). The Niobium samples were supplied by the *Fermi National Accelerator Laboratory, Illinois* USA and were characterized (surface state, chemical composition and crystallographic orientation) at ICMO, Orsay. These results complement previous measurements of the Kapitza resistance with polycrystalline Niobium, the whole set constituting a benchmark for the conception of superconducting cavities. Current numerical simulations study how hotspots occur during operation.
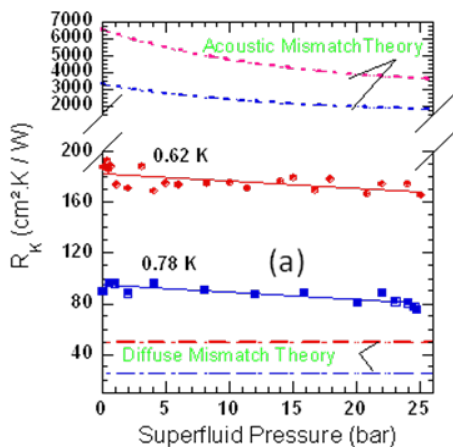
Figure 13 - Kapitza resistance at the interface Si/He as a function of pressure at two temperatures (0.62 and 0.78K).
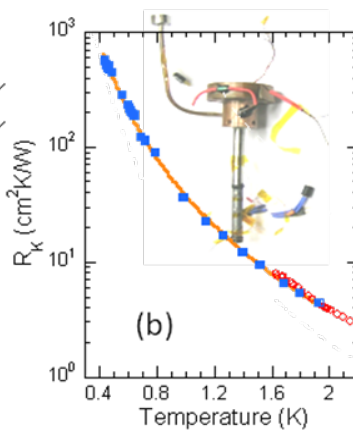
Figure 14 - Kapitza resistance at the interface Si/He under SVP pressure as a function of temperature. Experimental cell also shown in the insert.
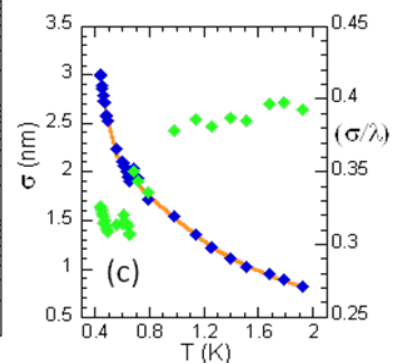
Figure 15 - Nanometer scale surface roughness (squares) required to interpret data and roughness-to-wavelength ratio (diamonds) characterizing the nature of scattering.

Studies on heat transfer in nanowires and micro- or nano-junctions started four years ago in close collaboration with S. Volz (EM2C Laboratory, ECP), and also with F. Parrain (IEF, Orsay) and O. Bourgeois (Institut Louis Néel, Grenoble) for sample preparation and detector manufacturing. The role of the thermal boundary resistance between a metallic nanowire and its substrates, and its dependence on the nanowire diameters, were investigated for electronic ballistic heat transport (Venkatesh *et al.*, 2011). Currently, the

PhD student A. Ramiere studies thermal transport in micro-junctions in the ballistic regime. The purpose is to establish new physical laws from which one could evaluate energy dissipation in micro- or nano-electronic systems at ambient temperatures. This subject is very active internationally, and the joint project *ERéthiques-Jonctions* (LIMSI, EM2C and IEF) has recently been selected for being funded by the Labex *LASIPS*.

Lastly, we performed preliminary studies on the effects of turbulence on the heat transfer coefficient in a cryogenic heat exchanger which, in the meantime, has been designed and built (Amrit *et al.*, *EJP*, 2012).

Topic 4: Applied convective transfers

M. Pons, *V. Bourdin, M. Firdaouss, S. Wullens (PhD)*

Our group has a historical interest in refrigeration, more especially in solar-powered refrigeration. We therefore contributed to the ANR project *Orasol*, aiming to compare, on a sound basis, the performance of six solar-powered air-conditioners of various sizes, based on four different principles (liquid or solid sorption, continuous or discontinuous cycles, closed or open cycles), and tested in five different places (from La Rochelle on the Atlantic coast to the tropical island La Réunion). We developed a thermodynamic approach based on non-dimensional energy- and mass-fluxes. It globally describes the energetic behavior of the units, from incident solar energy to cold production via heat input into the sorption unit, while considering heat rejection to the atmosphere, electricity consumption by auxiliaries, and water consumption when relevant. Thanks to that analysis, comparison between the performance recorded during the past two years gives comprehensive insight on features such as possible degradation of the solar collectors from one year to the next, or quantitative differences between continuous cycles (liquid sorption or rotary desiccant wheel) and discontinuous ones (solid sorption). The electricity consumption of solar air-conditioners is usually neglected in the literature although its reduction is expected to be the main environmental benefit of that technique. Our study highlights that the initial design of the unit, and more precisely of the system through which heat is rejected to the atmosphere, is extremely important with respect to that consumption. The article resulting from that long-term survey has recently been submitted to *Energy*[12]. The *Orasol* project also gave the opportunity to apply exergy analysis, another specialty of our group, to solar-powered systems. In a first step, we established the method for evaluating the exergy content of solar radiation at the terrestrial level[13]. We can now identify the exergy losses which are specific to given use of solar energy: with or without concentration, for thermal or photovoltaic conversion[14]. This topic extends in two directions: (i) study of the exergy balance with low-concentration (recently started thesis on solar thermodynamic conversion heat-electricity, in co-direction with PIMENT), (ii) study of photovoltaic conversion enhanced by low-concentration (recently started collaboration of V. Bourdin with N. Migan, LGEP Orsay).

Strictly thinking in terms of energy consumption, air-conditioners should be avoided. Nocturnal ventilation is one way to refresh buildings at night, and to delay, hopefully to cancel, the moment when air-conditioning is switched-on at daytime. The design of an efficient ventilation system requires reliable numerical simulation of flows in buildings. Because of (i) the high values of the Reynolds and Rayleigh numbers, (ii) the complexity of spatial configurations, and (iii) the long-term period of interest, such numerical simulations are still very challenging. The project *ADNBATI* (financed by Programme *Energie* of CNRS) aims to gather academic laboratories (CEA/LEB, PIMENT, GRESPI/LTM, LaSIE) and engineering consultants (NOBATEK, CENAERO) around one common case corresponding to a real building and in reach of numerical simulations with refined models. The novel accommodation building of the Institut d'Études Scientifiques de Cargèse, named after G. Charpak, consists of two rows of bedrooms, symmetric with respect to their neighbors and opened to the outside on both their East and West sides. These two openings were designed for allowing natural ventilation to set in at night. Cooling by nocturnal ventilation solely induced by the temperature difference between indoor and outdoor atmospheres was simulated using the widest possible range of methods: from simple analytical formulae (method #1) to Direct Numerical Simulation (method #7), including nodal models (#2), TRNSYS-CONTAM (#3), zonal model (#4), under-resolved laminar CFD (#5), under-resolved turbulent CFD (#6). The dispersion between CFD methods, probably due to under-resolution, is negligible compared to overestimation by non-CFD methods, +20% on the flow-rate,

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[12] Pons M., Anies G., Boudehenn F., Bourdoukan P., Castaing-Lasvignottes J., Evola G., Le Denn A., Le Pierrès N., Marc O., Mazet N., Stitou D., and Lucas F., Performance comparison of six solar-powered air-conditioners operated in five places, *Energy*, submitted december 2011, ref EGY-D-11-02269.

[13] Pons M., Bases for second law analyses of solar-powered systems, Part 1: the exergy of solar radiation, *ECOS-2008 21st Int. Conf. on Efficiency, Cost, Optimization, Simulation & Environmental Impact of Energy Systems*, Cracow-Gliwice, Poland, 24-27 June 2008, A. Ziebik et al. Ed., Pub. AGH Univ. Sci. Technol., ISBN 978 83 922381 4 0, Vol. 1, pp. 139-146, 2008.

[14] Pons M., Exergy analysis of solar collectors, from incident radiation to dissipation, article in press in *Renewable Energy* (2012) doi:10.1016/j.renene.2012.03.040.

but a factor of 2 on the cooling rate, see Figure 16. The error on the flow-rate may be acceptable, but that on the cooling rate needs deeper analysis. The first three non-CFD methods (#1-#3) rely on the concept of volume mixing, assuming that each room can be represented by one value for pressure, and for temperature as well. Moreover, this average temperature is determined *a priori* by an arithmetic mean instead of resulting from a heat balance. In contrast, CFD simulations demonstrate that the effective air temperature at the exit opening is significantly less than the arithmetic mean value, see Figure 17. This work extends in two directions. First, boundary conditions on pressure are being implemented in the numerical codes of LIMSI (S. Wullens' PhD), for us to be able to simulate such configurations with our own algorithms.
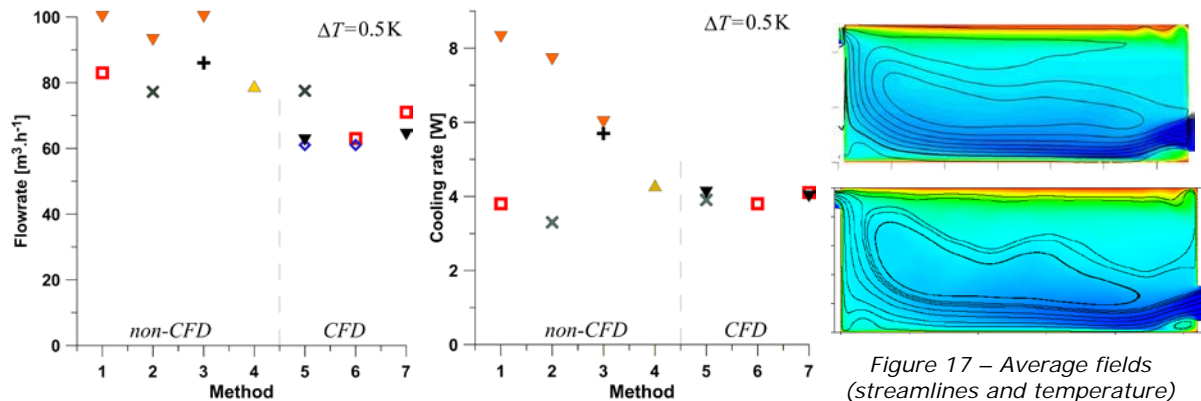
Figure 16 – Comparison of the results given by the seven investigated methods: average ventilation flow-rate (left) and cooling rate (right).

Figure 17 – Average fields (streamlines and temperature) calculated with method #7 (LEB and PIMENT). Air enters the room at the bottom right, and exits at the top left.

Secondly, we wonder whether recirculation of the flow shown in Figure 17 is an artifact or a physical phenomenon. This issue was addressed for the academic case of a 2D square cavity heated from below. The equations are solved in the *stream function-vorticity* formulation[15]; results are presented in Figure 18. The two-cell flow calculated for *Ra* close to 10^7 does have some similarity with the recirculation observed in the test-case ADNBATI. This latter study should be extended to unsteady flows generated by larger values of *Ra*.
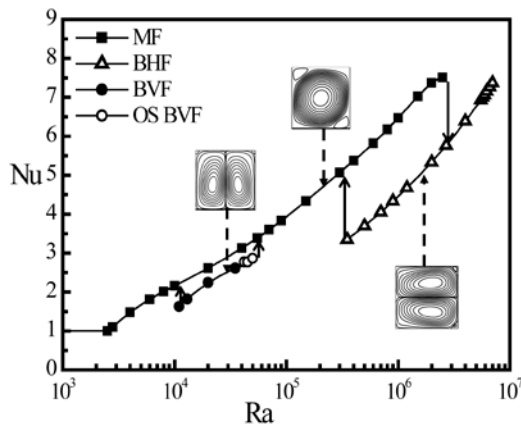
Figure 18 – Flow-pattern phase-diagram in 2D square cavity heated from below. The mono-cellular flow pattern (MF), basic to this geometry, sets on at $Ra>2.5x10^3$. In the range $Ra=1.1x10^4-4.1x10^4$, solutions can be multiple, between 1-cell and 2-vertical-cells (BVF), but with a very tiny difference in the Nusselt number. For $4.1x10^4< Ra< 3.5x10^5$, only the mono-cell flow MF can exist. Beyond the latter value another two-cell flow, now horizontal (BHF), can set in. However, transition between MF and BHF displays a hysteresis: transition from MF to BHF occurs at $Ra=2.5x10^6$, while the reverse transition occurs at $Ra=3.5x10^5$.

Highlights

- Good agreement was obtained between numerical simulations and experiments for the jet resulting from the fall of a liquid drop on a solid surface.
- A massively parallel version of the numerical code for incompressible two-phase flows using the front tracking technique for following the interface was developed and implemented.
- For the first time, Faraday waves exhibiting a pentagonal quasi-crystal pattern were calculated numerically, in good agreement with experimental observations. The long time dynamics,

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[15] A. Raji, M. Hasmaoui, M. Fidaouss, Effect of a periodic cooling on natural convection heat transfer in a square cavity heated from below, revised version submitted to *J. Enhanced Heat Transfer* (2012).

symmetries and Fourier spectra of an exotic regime of hexagonal patterns in Faraday waves characterized by an alternating appearance of quasi-hexagon and beaded stripe patterns were simulated and interpreted in the context of a heteroclinic cycle.

- Numerical methods were developed and validated for simulating separate bubbles (discontinuous compressible gas phase) enclosed in a liquid volume.
- The secondary flows (streaming) occurring in an acoustic resonator were simulated numerically in the non-linear regime. The results qualitatively confirmed previous experimental observations at LIMSI; a good quantitative agreement with measurements performed in the Prime Institute (Poitiers) was obtained. The second order flow (streaming) was extracted from LDV measurements of the acoustic velocity field in a 2m long acoustic resonator.
- A new model was developed for the analysis of simplified thermoacoustic engines. The viscous and heat conducting flow model of the active thermoacoustic cell was properly coupled, through a Low Mach number asymptotic analysis, with linear acoustics in the left and right parts of the tube.
- For the first time the Kapitza resistance between a Silicon single-crystal and superfluid Helium at 0.4K was measured. The Kapitza resistance was measured as a function of superfluid Helium pressure, ranging from Standard Vapor Pressure to 25 bars, and at various temperatures.
- A robust framework was established for defining the exergy transported by solar radiation in terrestrial environment. Consequences on efficiency of solar collectors were drawn.
- In August 2011, an international symposium was organized in Warsaw in honor of François Feuillebois' 65th birthday: Microparticles in Stokes Flows (URL: http://microparticles2011.ippt.gov.pl/).

Staff

Permanent Staff

Firstname	Lastname	Type of position	Employer	HDR	Arrival date	Departure date
Jairaj	Amrit	Ass. Prof.	U-PSud	HDR		
Diana	Baltean	Ass. Prof.	UPMC			
Gérard	Defresne	Ass. Prof.	U-PSud			
Marie-Christine	Duluc	Ass. Prof.	CNAM	HDR		
François	Feuillebois	DR	CNRS	HDR	01/01/2010	Retired on 01/09/2011
Mouaouia	Firdaouss	Ass. Prof.	UPMC	HDR		
Maurice-Xavier	François	Prof.	UPMC	HDR		Retired on 31/12/2011
Fathi	Jebali Jerbi	Ass. Prof.	UPMC			
Damir	Juric	CR	CNRS			
Smaïne	Kouidri	Prof.	UPMC	HDR		
Michel	Pons	CR	CNRS	HDR		

PhD Students

Firstname	Lastname	Graduate school	University	Type of support	Start date	Date of defense
Omar	Hireche		Univ. d'Oran	Algeria PhD grant	01/10/2007	31/10/2010
Richard	Paridaens	SMAER	UPMC	UPMC PhD grant	15/09/2009	
Nicolas	Perinet	SMAER	UPMC	MNRT PhD grant	01/10/2007	17/12/2010
Guillaume	Prigent	Physique Macro.	U-PSud	U-PSud PhD grant	01/10/2009	
Aymeric	Ramière	MIPEGE	U-PSud	U-PSud PhD grant	01/10/2011	
Sébastien	Wullens	SISEO	Univ. Chambéry	CDD CNRS Rhône Alpes - ANR 4C	01/09/2010	

Non permanent staff

Firstname	Lastname	Type of position	Employer	Arrival date	Departure date
Irina Marx	Chhay	Post-Doc	CNRS	01/09/2009	31/08/2010

Indicators of scientific notoriety

Editorial board appointments

- F. Feuillebois and A. Sellier Ed., *Theoretical Methods for micro scale viscous flows*, Pub. Transworld Research Network, 2009.

Organization of international or national scientific events

Member of the scientific, technical program and/or organizational committees for international/national conferences or workshops

- D. Baltean-Carlès and S. Kouidri were members of both organizing and scientific committees of the 1st summer school on Thermoacoustics, endorsed by CNRS, held in Roscoff, May 30-June 4, 2010 (42 participants).
- S. Kouidri is member of Int. technical committee of the 26th IAHR Symposium on Hydraulic Machinery and Systems, Tsinghua Univ., Beijing China, August 19–23, 2012 (300 participants).
- M. Pons was President of the scientific committee of the Spring school SIMUREX, endorsed by CNRS, held in IES Cargèse, April 18-24, 2010 (100 participants).

Invited lectures, talks or seminars

Keynote speaker at international conferences

- F. Feuillebois, Methods for the coupled Stokes-Darcy problem, in *Second Conference of the Euro-American Consortium for Promoting the Application of Mathematics in Technical and Natural Sciences (2nd AMiTaNS)*, Sozopol, Bulgaria, June 21-26, 2010. Keynote lecture.
- F. Feuillebois, Motion of particles in a parabolic flow near a slip wall, in *Third Conference of the Euro-American Consortium for Promoting the Application of Mathematics in Technical and Natural Sciences (3rd AMiTaNS)*, Albena, Bulgaria, June 20-25, 2011. Keynote lecture.
- S. Kouidri, Investigations on unsteady wall-pressure measurement on the blade of axial flow fans for aeroacoustics purpose, Int. Conf. Pumps and Fans,ICPF2010, Hangzhou China, October 18-21, 2010. Keynote lecture.

Tutorials at workshops, conferences or summer schools

- D. Baltean-Carlès, Concept and theory of thermoacoustics, *Internship in Thermoacoustics (FPO/SFV/IPN)*, France, 2009, 2010.
- D. Baltean-Carlès, A thermoacoustic prime-mover prototype, lab class at the *1st summer school on Thermoacoustics*, Roscoff, May 30-June 4, 2010.
- F. Feuillebois, Écoulements à petit nombre de Reynolds, in *Summer School and Workshop on Numerical Methods for Interactions between Sediments and Water, LAGA* - Paris 13 Nord Univ. Villetaneuse, September 20-24, 2010. Invited conference.
- M. Pons, The ADNBATI benchmark, Lab class at *École thématique SIMUREX*, endorsed by CNRS, IES Cargèse France, April 18-24, 2010.
- M. Pons, Le froid solaire, Lecture at the *Summer School ENERSI* (ÉNErgies Renouvelables et Systèmes Intelligents) , Univ. Savoie, Le Bourget du Lac, August 30 – September 3, 2010.

Invited talks (national or international)

- F. Feuillebois, Motion of particles in a viscous fluid near a slip wall, in *19th Polish National Fluid Dynamics Conference*, Poznan, Poland, September 5-9, 2010. Invited lecture.
- F. Feuillebois, Influence of wall slip in dilute suspensions, in *Microparticles in Stokes flows, International symposium in honor of François Feuillebois' 65th birthday*, Warsaw, Poland, August 22-26, 2011.
- S. Kouidri, *Nonlinear Phenomena in Thermoacoustic Engines and Energetic Efficiency, in National Conf. on Energy, Sen2012, Algiers Algeria, March 25-27, 2012. Invited lecture.*

Participation in expertise and administration of research

International or national scientific networking

International networks

- D. Baltean-Carlès: Participant in the CMEP program 10MDU809 (directed by P. Le Quéré) for a French-Algerian collaboration on *A numerical and experimental study of thermoacoustic systems* (2010-2014), within the framework of the Hubert Curien Tassili program.

- F. Feuillebois: French responsible scientist for a three-year (2009-2011) *PICS* French-Polish cooperative agreement between CNRS and IPPT, Polish Academy of Sciences, on *Hydrodynamic interactions in suspensions*.
- F. Feuillebois: Participant in two-years (2010-2011) cooperative agreement N° 23897 between CNRS and Bulgarian Academy of Sciences, on *Freezing of a flowing liquid film and application to icing*.

National networks or working groups

- J. Amrit contributes to the Fédération TM&C and to the GdRe *Thermal Nanosciences and Nanoengineering*, due to his collaboration with S. Volz.
- D. Baltean-Carlès, F. Jebali, S. Kouidri, and M. Pons contribute to the *GdR Thermoacoustique*.

Participation in evaluation or expertise committees

National committees (CoNRS, CNU, CCSU…)

- CCSU 60-61-62 of Univ. Paris-Sud: J. Amrit and M. Pons, with active participation of J. Amrit to the CdS from 2009 to 2012.
- CCSU 60 of UPMC (2004-2011): D. Baltean and M. Pons, with active participation of M. Pons to the CdS in 2010.
- CCSU 60 of INPL Nancy 2009-2012: M. Firdaouss.
- CCSU 60-62 of Univ. Paris-Est Marne-la-Vallée 2010-2011: M.-C. Duluc.
- CCSU 60-62 of UJF Genoble 2009: M.-C. Duluc.
- CCSU 60-62 of Arts et Métiers ParisTech 2010-2012: S. Kouidri

Expert for scientific evaluation committees

- S. Kouidri : expert for scientific evaluation for Ministère de l'Enseignement Supérieur et de la Recherche, Crédit Impôt Recherche.
- S. Kouidri: scientific expert and member of Scientific Committee of Laboratoire National de Métrologie et d'Essais.

Member of selection juries

- M.-C. Duluc: jury member for the Agrégation Mécanique 2009-2012.

Teaching activities and duties in relation to research

- V. Bourdin: two graduate lecture courses on *Renewable Energies and Energetic Efficiency* in the Master's degree Physique et Applications de la Mécanique at Univ. Paris-Sud, one for the option DFE and the other for the option PIE.
- F. Feuillebois: graduate lecture course in the Master's degree in Mechanics at Univ. Pierre et Marie Curie (Paris 6): *Suspensions and two-phase media*.
- F. Feuillebois: graduate lecture course in the Master's degree in Engineering Mathematics at École Polytechnique de Tunisie, La Marsa, Tunisia: *Modeling of effective properties of heterogeneous random media*.
- D. Baltean-Carlès: graduate lecture course in the M1 Master SDI (EE --MF2A) at Univ. Pierre et Marie Curie (Paris 6): *Energy and environmental impact* (2009-2011).
- M.-C. Duluc: graduate lecture course in the Master's degree in Physique des Énergies at Univ. Paris-Diderot: (i) *Forced convection*; (ii) *Pool boiling*.
- M. Firdaouss: graduate lecture courses in the Master's degree Mécanique des Fluides, at Univ. Pierre et Marie Curie: (i) *Flows in Natural Media* and (ii) *Numerical Methods in Fluid Mechanics*.
- S. Kouidri: (i) Internal Flow in Turbomachinery, at UPMC (ii) Aeroacoustics and Noise Pollution at Arts & Métiers Paristech and Univ. Pierre et Marie Curie (UPMC).
- M. Pons: graduate lecture course in the master's degree DFE at Univ. Paris-Sud: *Thermique du Bâtiment*.
- M. Pons: graduate lecture courses in the master's degree Physique des Énergies at Univ. Paris-Diderot: (i) *Desiccant cooling*; (ii) *Radiative Heat Transfer* ; (iii) *Natural Convection*.
- M. Pons: graduate lecture courses in the master's degree OMEBA at Univ. Pierre et Marie Curie: *Solar-Powered Refrigeration*.

Research conventions and contracts

Industrial relationships

- F. Feuillebois: Contract for thesis supervision, IRSN, Saclay, 2010-2011.

Contract table

Acronym	Funding agency/Partner	Program	Nature	Resp. for LIMSI	General coordinator	Starting date	Ending date	LIMSI share
ORASOL	ANR	PREBAT	Research collab.	Pons M.	L. Franck	17/04/2007	17/01/2011	45320
Irréversibilités dessicantes	University La Rochelle		Research collab.	Pons M.	Pons M.	09/08/2007	08/08/2010	
	IRSN	PhD Supervision	Research collab.	Feuillebois F.	Feuillebois F.	17/11/2008	16/11/2011	60000
Coalescence	Saint Gobain Recherche		Research collab.	Juric D.	Juric D.	23/01/2009	22/01/2010	20000
AND BATI	CNRS	Programme interdisciplinaire Energie	Research support	Pons M.	Pons M.	01/01/2009	30/04/2010	7500
Kapitza	IPNO		Research collab.	Amrit J.	Amrit J.	01/04/2009	31/03/2012	
	CNRS	Partnership with IPPT Poland	Research collab.	Feuillebois F.	Feuillebois F.	01/01/2010	31/12/2011	10000
CLIMB	CEA		Research collab.	Pons M.	M. Gmar	01/01/2010	31/12/2010	8000
GAT Habitat	CNRS	Programme interdisciplinaire Energie	Research support	Pons M.	Peuportier B.	01/06/2010	30/04/2010	13000
	PRES UniverSud		Research support	Amrit J.	J. Amrit	01/04/2011	30/09/2011	2500

Scientific publications

Doctoral theses and HDR

T1. Périnet, N., *Simulation numérique des ondes de Faraday* 2010, thèse de l'Université Pierre et Marie Curie. Soutenue à l'ESPCI, Paris, le 17 décembre 2010, 129 p.

Articles in peer reviewed scientific journals

A1. Amrit, J., *Impact of surface roughness temperature dependency on the thermal contact resistance between Si(111) and liquid 4He.* Physical Review B, 2010. **81** (5): pp.054303_1-054303_10.

A2. Amrit, J. and C. Antoine, *Kapitza resistance cooling of single crystal (111) niobium for superconducting rf cavities.* Physical Review Special Topics - Accelerators and Beams, 2010. **13** (2): pp.023201_1-023201_8.

A3. Daru, V., P. Le Quéré, M.-C. Duluc, and O. Le Maitre, *A numerical method for the simulation of low Mach number liquid-gas flows.* Journal of Computational Physics, 2010. **229** (23): pp.8844-8867.

A4. Debbech, A., L. Elasmi, and F. Feuillebois, *The method of fundamental solution for the creeping flow around a sphere close to a membrane.* Journal of Applied Mathematics and Mechanics / Zeitschrift für Angewandte Mathematik und Mechanik (ZAMM), 2010. **90** (12): pp.920-928.

A5. Feuillebois, F., M. Bazant, and O. Vinogradova, *Transverse flow in thin superhydrophobic channels.* Physical Review E, 2010. **82** (5): pp.055301_1-055301-4.

A6. Feuillebois, F. and M. Ekiel-Jezewska, *Suspensions de particules et interactions hydrodynamiques dans un fluide visqueux.* Annales de l'Académie Polonaise des Sciences à Paris, 2010. **12**: pp.44-61.

A7. Firdaouss, M. and M. Pons, *Condition for neglecting upstream conditions when simulating flow in granular beds.* Journal of Porous Media, 2011. **14** (10): pp.943-949.

A8. Fisher, M., D. Juric, and D. Poulikakos, *Large convective heat transfer enhancement in microchannels with a train of coflowing immiscible or colloidal droplets.* Journal of Heat Transfer, 2010. **132** (11): pp.112402_1-112402_10.

A9. Hedhili, L., A. Sellier, L. Elasmi, and F. Feuillebois, *Motion of small solid particles in a viscous fluid enclosed in a cavity.* Computer Modeling in Engineering & Sciences, 2011. **73** (2): pp.137-170.

A10. Hireche, O., C. Weisman, D. Baltean, P. Le Quéré, and L. Bauwens, *Low Mach number analysis of idealized thermoacoustic engines with numerical solution.* Journal of the Acoustical Society of America, 2010. **128** (6): pp.3438-3448.

A11. Hireche, O., C. Weisman, D. Baltean, P. Le Quéré, M.X. François, and L. Bauwens, *Numerical model of a thermoacoustic engine.* Comptes Rendus Mecanique, 2010. **338** (1): pp.18-23.

A12. Hurault, J., S. Kouidri, F. Bakir, and R. Rey, *Experimental and numerical study of the sweep effect on three-dimensional flow downstream of axial flow fans.* Flow Measurement and Instrumentation, 2010. **21** (2): pp.155-165.

A13. Khabthani, S., L. Elasmi, and F. Feuillebois, *Perturbation solution of the coupled Stokes-Darcy problem.* Discrete and Continuous Dynamical Systems Series B, 2011. **15** (4): pp.971-990.

A14. Mongruel, A., C. Lamriben, G. Yahiaoui, and F. Feuillebois, *The approach of a sphere to a wall at finite Reynolds number.* Journal of Fluid Mechanics, 2010. **661**: pp.229-238.

A15. Mongruel, A., N. Lecoq, E. Wajnryb, B. Cichocki, and F. Feuillebois, *Motion of a sphero-cylindrical particle in a viscous fluid in confined geometry.* European Journal of Mechanics - B/Fluids, 2011. **30** (4): pp.405-408.

A16. Pasol, L., M. Martin, M. Ekiel-Jezewska, E. Wajnryb, J. Blawzdziewicz, and F. Feuillebois, *Motion of a sphere parallel to plane walls in a Poiseuille flow. Application to field-flow fractionation and hydrodynamic chromatography.* Chemical Engineering Science, 2011. **66** (18): pp.4078-4089.

A17. Rabe, C., J. Malet, and F. Feuillebois, *Experimental investigation of water droplet binary collisions and description of outcomes with a symmetric Weber number.* Physics of Fluids, 2010. **22** (4): pp.047101_1-047101_11.

A18. Shin, S., I. Yoon, and D. Juric, *The local front reconstruction method for direct simulation of two- and three-dimensional multiphase flows.* Journal of Computational Physics, 2011. **230** (17): pp.6605-6646.

A19. Venkatesh, R., J. Amrit, Y. Chalopin, and S. Volz, *Thermal resistance of metal nanowire junctions in the ballistic regime.* Physical Review B, 2011. **83** (11): pp.115425_1-115425-5.

Books & chapters in books

B1. Feuillebois, F., N. Ghalya, A. Sellier, and L. Elasmi, Motion of particles in a parabolic flow near a slip wall, in Applications of Mathematics in Technical and Natural Sciences. (Proceedings of the 3rd International Conference AMiTaNS 2011), M.D. Todorov and C.I.E. Christov, Eds. 2011, American Institute of Physics Conference Proceedings, vol. 1404. pp. 340-351.

B2. Feuillebois, F., S. Khabthani, L. Elasmi, and A. Sellier, Methods for the coupled Stokes-Darcy problem, in Applications of Mathematics in Technical and Natural Sciences. (Proceedings of the 2nd International Conference AMiTaNS 2010), M.D. Todorov and C.I.E. Christov, Eds. 2010, American Institute of Physics Conference Proceedings, vol. 1301. pp. 14-25.

Conferences with proceedings and review committee

C1. Brangeon, B., A. Bastide, P. Joubert, and M. Pons. *Étude numérique de la ventilation traversante naturelle dans une cavité ouverte - Application au rafraîchissement passif des locaux.* in *Congrès Français de Thermique.* 2011. Perpignan, France. 213-218.

C2. Brangeon, B., A. Bastide, P. Joubert, and M. Pons. *Numerical investigation of natural convection in a cavity using an open geometry.* in *International Conference on Indoor Air Quality and Climate.* 2011. Austin, USA. 6p.

C3. Daru, V., D. Baltean, G. Gandikota, and C. Weisman. *Etude numérique du vent acoustique non linéaire dans un résonateur à ondes stationnaires.* in *Congrès Français de Mécanique.* 2011. Besançon, France. 1190_1-1190_6.

C4. Foissac, A., J. Malet, S. Mimouni, and F. Feuillebois. *Binary water droplet collision study in presence of solid aerosols in air.* in *International Conference on Multiphase Flow.* 2010. Tampa, USA. 8p.

C5. Foissac, A., J. Malet, S. Mimouni, P. Ruyer, F. Feuillebois, and O. Simonin. *Eulerian simulation of interacting PWR sprays : influence of droplet collisions.* in *International Topical Meeting on Nuclear Reactor Thermal Hydraulics.* 2011. Toronto, Ontario, Canada. 111_1-111_12.

C6. Hurault, J., S. Kouidri, F. Bakir, and R. Rey. *Amiet formulation and semi-empirical models for trailing edge noise prediction in axial flow fans.* in *Conference on Thermal and Environmental Issues in Energy Systems.* 2010. Sorrento, Italy. 6p.

C7. Jebali Jerbi, F., G. Huelsz, P. Lotton, and S. Kouidri. *Quelques aspects liés aux différents niveaux de l'amplitude de vitesse acoustique mesurée par anémométrie fil chaud.* in *Congrès Français d'Acoustique.* 2010. Lyon, France. 6p.

C8. Kouidri, S., F. Jebali Jerbi, and R. Paridaens. *Pression moyenne temporelle d'ordre deux dans les systèmes thermoacoustiques.* in *Congrès Français d'Acoustique.* 2010. Lyon, France. 5p.

C9. Kouidri, S., F. Jebali Jerbi, and R. Paridaens. *Nonlinear phenomena in thermoacoustic engines.* in *Conference on Thermal and Environmental Issues in Energy Systems.* 2010. Sorrento, Italy. 5p.

C10. Paridaens, R., S. Kouidri, and F. Jebali Jerbi. *Caractérisation des écoulements redressés dans les moteurs thermoacoustiques à ondes progressives.* in *Congrès Français de Mécanique.* 2011. Besançon, France. 456_1- 456_6.

C11. Paridaens, R., S. Kouidri, and F. Jebali Jerbi. *DC flow investigations in thermoacoustic prime mover.* in *ASME International Mechanical Engineering Congress & Exposition.* 2011. Denver, USA. 1-6.

C12. Périnet, N., D. Juric, and L. Tuckerman. *A numerical study of Faraday waves.* in *International Conference on Multiphase Flow.* 2010. Tampa, USA. 12p.

C13. Pons, M. *Exergy budget of solar collector: thermal vs. photovoltaic*. in *International Conference on Efficiency, Cost, Optimization Simulation and Environmental Impact of Energy Systems*. 2011. Novi Sad, Serbia. 3232-3243.

C14. Pons, M., A. Bastide, B. Brangeon, E. Wurtz, L. Stephan, C. Goffaux, A. Jay, C. Maalouf, and P. Salagnac. *The test case ADNBATI, a benchmark on natural ventilation in a room*. in *International Conference on Advanced Computational Methods in Engineering*. 2011. Liège, Belgium: M. Hogge et al. 10p.

C15. Pons, M., M. Chhay, J. Chergui, and E. Wurtz. *Une méthode multi-niveaux pour coupler radiation et advection-diffusion*. in *Congrès Français de Thermique*. 2011. Perpignan, France. 325-330.

C16. Weisman, C., D. Baltean, P. Le Quéré, and L. Bauwens. *Modèle faible Mach et simulations numériques 2D de l'amplification d'onde thermoacoustique*. in *Congrès Français d'Acoustique*. 2010. Lyon, France. 6p.

C17. Weisman, C., D. Baltean, P. Le Quéré, and L. Bauwens. *Numerical study of thermoacoustic wave amplification*. in *European Conference on Computational Fluid Dynamics*. 2010. Lisbon, Portugal. 9p.

C18. Weisman, C., D. Baltean, P. Le Quéré, and L. Bauwens. *Comparison of different heat exchanger models in a thermoacoustic engine simulation*. in *Joint US-European Fluids Engineering Summer Meeting and 8th International Conference on Nanochannels, Microchannels, and Minichannels*. 2010. Montreal, Canada. 8p.

C19. Weisman, C., D. Baltean, P. Le Quéré, and L. Bauwens. *Modélisation nonlinéaire des écoulements et transferts de la cellule active d'un moteur thermoacoustique*. in *Congrès Français de Mécanique*. 2011. Besançon, France. 669_1-669_6.

Conferences without proceedings, workshops

D1. Amrit, J. *On surface roughness and conduction across boundaries and in mesoscopic bulk*. in *ICREA Workshop on Phonon Engineering 2010*. 2010.

D2. Asmolov, E. and F. Feuillebois. *Disturbance flow of a non-neutrally buoyant sphere in an unbounded linear shear flow*. in *European Fluid Mechanics Conference*. 2010. Bad Reichenhall, Germany.

D3. Ferchichi, Y., A. Mongruel, F. Feuillebois, and H. Duval. *Effet des forces de lubrification sur le mouvement des inclusions à l'approche de l'interface métal liquide/laitier*. in *Journées Annuelles de la Société Française de Métallurgie et de Matériaux (JA SF2M 2011)*. 2011: SF2M.

D4. Feuillebois, F., N. Ghalya, A. Sellier, and L. Elasmi. *Influence of wall slip in dilute suspensions*. in *Microparticles in Stokes flows, Symposium in honor of François Feuillebois' 65th birthday*. 2011. Warsaw, Poland: IOP Conference Series. 1-19.

D5. Feuillebois, F., H. Loussaief, S. Khabthani, and L. Elasmi. *Motion of particles in a viscous fluid near a slip wall*. in *Polish National Fluid Dynamics Conference*. 2010. Poznan, Poland.

D6. Foissac, A., J. Alengri, J. Malet, S. Mimouni, and F. Feuillebois. *Etude de la collision binaire de gouttes d'eau en présence d'aérosols*. in *congrès français sur les aérosols*. 2011. Paris, France.

D7. Foissac, A., J. Malet, R. Vetrano, J. Buchlin, S. Mimouni, F. Feuillebois, and O. Simonin. *Experimental measurements of droplet size and velocity distributions at the outlet of a pressurized water reactor containment swirling spray nozzle*. in *CFD4NRS-3. CFD for Nuclear Reactor Safety Applications Workshop*. 2010.

D8. Ghalya, N., A. Sellier, and F. Feuillebois. *Migration of a solid and arbitrarily-shaped particle near a plane slipping wall*. in *Microparticles in Stokes flows, Symposium in honor of François Feuillebois' 65th birthday*. 2011. Warsaw, Poland: IOP Conference Series (2012). 1-8.

D9. Kouidri, S. *Aeroacoustic modeling in subsonic turbomachines*. in *International Conference on Pumps and Fans*. 2010. Hangzhou, China.

D10. Périnet, N., D. Juric, and L. Tuckerman. *Numerical Investigation of the Faraday Instability*. in *European Postgraduate Fluid Dynamics Conference*. 2010. Paris, France.

D11. Périnet, N., D. Juric, and L. Tuckerman. *Numerical Investigation of the Faraday Instability*. in *Conference of the International Marangoni Association, Interfacial Fluid Dynamics and Processes*. 2010. Florence, Italy.

D12. Périnet, N., D. Juric, and L. Tuckerman. *Numerical Investigation of the Faraday Instability*. in *Joint SIAM/RSME-SCM-SEMA Meeting, Emerging Topics in Dynamical Systems and Partial Differential Equations*. 2010. Barcelona, Spain.

D13. Pons, M. *Second law, exergy, and consequences on low-temperature heat-recovery*. in *Energy for Sustainable Science Workshop*. 2011: European Spallation Source, Lund, Sweden.

D14. Stephan, L., E. Wurtz, A. Bastide, B. Brangeon, A. Jay, C. Goffaux, and M. Pons. *Benchmark de ventilation naturelle traversante (ADNBATI)*. in *Conférence IBPSA France*. 2010. Moret-sur-Loing, France. 8p.

Information, Language, Written and Signed (ILES)

P<small>IERRE</small> Z<small>WEIGENBAUM</small>

Introduction

ILES stands for Information, Written and Signed Language. ILES specifically addresses the analysis, understanding and production of *written language*, and the modelling and production of *signed language* (see the TLP group for *spoken language* processing).

Natural language processing aims to process human language in such a way that the results of this processing make sense for humans, i.e., meet their expectations. It aims to make computer programs that can understand or emulate human communication, e.g. by analysing documents and extracting task-relevant information, helping in the production of documents (spell checkers, style checkers, controlled language editors), generating a whole document (text summarizer), or answering questions based on text or more structured content.

This motivates fundamental and applied research topics among which ILES addresses the following:

- A fundamental language processing function consists in knowing when two expressions have the same meaning (see Multilingualism and Paraphrasing).
- Because language is a means to convey information, searching and extracting information in language data is an important task (see Information Extraction, Focused Information Retrieval, and Question Answering --- abbreviated as Information Extraction in the cross-references in the present text).
- Sign language processing addresses a stringent societal demand; it requires fundamental modeling work and methods to generate realistic signed productions (*aka* virtual signer videos: see *Sign Language Modelling and Processing*).

Besides, natural language processing relies on algorithms and on knowledge used by these algorithms. This includes knowledge about language (e.g., morphology, lexicon, syntax, semantics, pragmatics) and about the world (e.g., the countries and cities of the world, or the signs and symptoms of known diseases). Modelling this knowledge and designing methods to acquire it are necessary activities in addition to the design of algorithms for language processing. ILES investigates both expert-based methods and data-driven methods for this purpose.

Finally, natural language processing generally associates natural language utterances with *representations* linked to such knowledge or to more applied tasks.

Specifying such representations and creating large corpora annotated with them is a foundational activity with a direct concrete impact on the definition, training, and evaluation of language processing systems (see Corpora and Representations).

The ILES group has natural relations with the other LIMSI Human Language Technology group, TLP, while retaining its specificity. Corpora and Representations are a common topic which spans both groups and on which we have strong collaborations, e.g. with S. Rosset (TLP). Multilingualism is at the heart of the Machine Translation activity led by TLP; and A. Max (ILES leader of this topic) contributes to that activity, and we have jointly started a LIMSI-supported project on cross-language transfer for information extraction. Information Extraction and Question Answering are also research topics in Speech Understanding, and we also collaborate with S. Rosset and colleagues on that.

The ILES groups has a tradition of collaborative work where several permanent staff, post-docs or PhD students often join forces and pool their specific competences on short-term topics and evaluations or on longer-term lines of research. Therefore the names attached to the presentation of each research topic below schematically characterize the topics to which each ILES member contributed the most significant share of their work; additionally, what can be considered the primary speciality of each member is marked by a star.

Research presentation

Topic 1: Corpora and Representations

P. Paroubek, *C. Grouin, M. Hurault-Plantet, C. Mouton, B. Cartoni, P. Albert with the participation of A. Braffort, M. Filhol, A. Max, X. Tannier, A. Vilnat, P. Zweigenbaum, B. Arnulphy, H. Bouamor, C. de Groc, J. Segouat, D. Bernhard, F. Badin, N. Devos*

The theme *Corpora and Representations* concerns the study of linguistic events as they are rendered through the graphical and signed symbolic systems used by humans to communicate. In our research, we explore corpora, i.e. document collections, gathered according to a work hypothesis, from various origins: speech transcriptions, books, articles, newspapers, reports, Web pages, blogs, microblogs, sign language videos, etc. Defining the target representation for a given NLP task (e.g. part-of-speech tagging, parsing, named entity recognition, opinion mining, etc.) is a foundational step in the study of the task and of its linguistic underpinnings. Creating annotated corpora according to these guidelines provides indispensable material for system development, training, or evaluation.

ILES has a track record of designing reference annotated corpora and organizing evaluation campaigns based on these corpora; our expertise in this domain gained us collaborations both in academia (ANR PASSAGE) and industry (Cap Digital DOXA). Note that sign language corpora are described with the *Sign Language Modelling and Processing* topic.

Annotated Corpora: Defining Representations

Identifying and representing linguistic events constitute the central step of corpus analysis and annotation. The theme *Corpora and Representations* precisely aims to elaborate definitions for the linguistic phenomena to be identified. These definitions need to be sufficiently clear and unambiguous, so that human annotators can mark the instances of the phenomena they find in corpora. The result of their work constitutes training/reference material which will be used for developing automatic identification algorithms, as is done for instance in the theme *Information Extraction.* The definition of the target linguistic phenomena is specified in a set of *annotations guidelines* which additionally describe how to solve difficult cases due to linguistic variations and to the semantic ambiguity present in all human communication. It is then embodied in a *reference annotated corpus* containing prototypical instances of the targeted phenomena, each of which has been annotated (markup) in the corpus. Furthermore, the annotation task requires the development of specific software with ergonomic interfaces to browse/manage the corpora and to build the different markup layers over the documents.

Illustration 1 - Opinion annotation in DOXA (Knowtator-Protégé, top-left) Syntactic annotation in PASSAGE (top) PASSAGE annotation interface (bottom-left)

In the current period we have coordinated or participated in the definition of annotations at several

linguistic levels in several application domains: syntactic annotations (PASSAGE ANR project and evaluation campaigns), named entities and events (QUAERO project and evaluation campaigns), time references, and opinions (DOXA CAP Digital project and DEFT evaluation campaigns). Similar work is performed in the scope of the sign language activities, but in that case the material to be annotated is video. It is important to note that in sign language too the multilingual dimension is present (Segouat et al., 2010), for instance in the DICTASIGN European project a good share of the work concerned the annotation of a reference corpus in the domain of transports for several signed European languages. The definition of the linguistic phenomena requires expertise from many domains: linguistics, communication sciences, digital libraries, statistics, graphical interfaces, database management, distributed computing...

Both the development of corpus usage in the industry and the apparition of new methods for producing large amounts of annotated material with the help of Web communities (crowdsourcing and serious gaming), in addition to raising ethical issues, bring the question of the scientific evaluation of the quality of the annotated corpora to the forefront of researchers' preoccupations. For a few years, we have been witnessing a regain of interest for statistical measures like Cohen's Kappa to ensure that annotations are build consistently by humans, a sine qua non condition for being able to apply machine learning on the annotated corpora. We are paying close attention to these issues, and incrementally set up procedures to quantify and ensure the quality and reliability of the annotated corpora we produce (Grouin et al., LAW 2011).

Annotated Corpora for Machine Learning and Evaluation

The design and production of annotated corpora is all the more important as nowadays, most Natural Language Processing applications use annotated corpora for machine learning, focusing on supervised methods such as Support Vector Machines and Bayesian Networks to complement traditional expert-based approaches. In ILES we do so for instance in information extraction, question answering and machine translation. Such corpora are also used in evaluation campaigns:

- to help appreciate the progress made in a domain,
- to gauge the level of performance reachable in a particular area,
- or to open new research directions in proposing innovative language processing tasks.

Within the Quaero project, in collaboration with S. Rosset (TLP), we proposed an extension of the classical named entity definitions (Grouin et al., LAW 2011). These extended named entities are hierarchical (with types and components) and compositional (with recursive type inclusion and metonymy annotation). Following these guidelines, we coordinated the annotation of two different corpora, one made of contemporary broadcast news and the other of OCRized old newspapers (December 1890), each containing about 1.5 million words.

Designing and deploying evaluation campaigns for language processing constitutes a sizeable share of our research activity in the theme *Corpora and Representations* (PASSAGE, QUAERO, DOXA, DEFT, INEX). In addition to defining and building a corpus with its annotations to serve as a gold standard, we also select or design evaluation measures and metrics to quantify the performance of natural language processing algorithms in evaluation campaigns. Knowledge from linguistics, statistics and information theory is then essential.
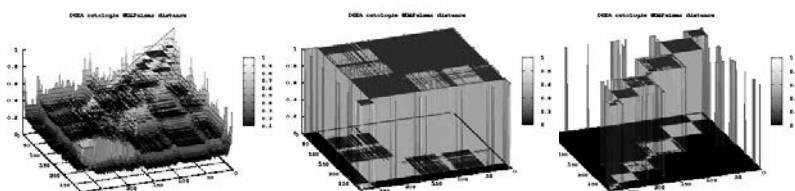
Illustration 2 - Inter-concept distance variation in DOXA measured with Wu & Palmer's measure, similarity radius of 0 then 0,3 and 0.6

Evaluation Metrics

Temporal information has been the focus of recent attention in information extraction. An important task consists in finding temporal relations between events in texts. This raises the problem of evaluation, because relations between events in a story are intrinsically interdependent and cannot be evaluated separately. We proposed a proper evaluation measure (Tannier and Muller, 2011) supported by an investigation of its properties on synthetic data and on a well-know temporal corpus.

Since 2009, LIMSI organizes (with LIA and IRIT) the task of tweet contextualization at the international INEX challenge (part of CLEF since 2012). The use case of this task is the following: given a new tweet,

the system must provide some context about the subject of the tweet, in order to help the reader understand it better. In this framework, we proposed some measures to evaluate informativeness and readability of summaries (SanJuan et al., 2011).

Since 2007, LIMSI organizes (with EBSI Montréal since 2010) the yearly DEFT text mining challenge. Suitable metrics are selected for each task; in some cases we need to propose new metrics. This was the case for instance for the year of publication detection task in DEFT 2011, where a Gaussian function of the distance of the hypothesis to the reference year was used to assign a mark to each hypothesized year (Grouin et al., DEFT 2011).

Topic 2: Multilingualism and Paraphrasing

A. Max, H. Bouamor, A. Bossard with the participation of V. Moriceau, X. Tannier, A. Vilnat, P. Zweigenbaum, B. Arnulphy, A. Ben Abacha, D. Bouamor, L. Deléger, D. Bernhard

By working on language productions with similar meanings but different forms, Multilingualism and Paraphrasing provide handles on semantics, the core of human language. At the same time, cross-language portability is a recurring issues in system development. This topic interacts in a transverse way with each of the other three research themes of the ILES group, as well as with the Machine Translation activity of TLP. It has also attracted a Japanese colleague for his sabbatical year which is to start in September 2012.

Contrasting NLP system results across languages

Different natural languages pose problems of different complexities to NLP systems. A frequent research objective in studies conducted in the ILES group is the contrastive study of NLP systems across languages.

The FIDJI Question Answering system was developed on both French and English (Moriceau and Tannier, 2010), showing that differences in resource availability and development efforts made adaptation from one language to another not straightforward.

Work on sub-sentential paraphrase acquisition was performed using several individual techniques and machine-learning-based combination using directly comparable resources on French and English (Bouamor et al., 2012a, 2011, 2010), showing that comparable results can be achieved on the two languages. A detailed contrastive typology of paraphrase phenomena was built (Bouamor et al., 2012c).

Work on Statistical Machine Translation has studied the relative contribution of several pivot languages in an efficient combination framework (Crego et al., 2010; Leusch et al., 2010). We showed for instance that French-German and French-English translation is most improved using predictions obtained from Spanish, and German-English from Greek and Danish, paving the way for further studies on language complementarity for Machine Translation.

Adapting Existing NLP Systems to New Languages

Once an NLP system has been developed for a language, it is useful to consider approaches to adapt it to new languages. This issue is tackled in ILES, using manual or lightly supervised approaches.

In the domain of Question Answering (see the Information Extraction topic below), the FIDJI system (Moriceau and Tannier, 2010) was initially developed on French, and syntactic analysis rules were then manually translated into English. An important aspect of the system is that these rules are the only (but important) language-dependent resources used by the system. However, results show that the more (language-dependent) resources one adds to the system, the better the results.

ILES has developed several entity annotation systems (see Information Extraction). For instance, medical entity annotation using hybrid techniques (Ben Abacha & Zweigenbaum, 2011) was initially developed on English, for which reference corpora exist. It was then ported to French by cross-lingual projection (Ben Abacha et al., 2012) along word alignment links. Our work so far showed an important drop in quality due to differences in corpora and to alignment difficulties. Parallel work is also ongoing in the context of the ANR EDyLex project, which targets general named entity annotation in news articles in English and French. The LIMSI-supported TraLaLa project coordinates and extends work performed along these lines in ILES and TLP; we have expanded this working group to our neighbouring colleagues of CEA LIST.

In the domain of Opinion mining, we have developed a language-independent approach to polarity mining. The approach has been tested in several international evaluation campaigns (Pak & Paroubek, Semeval 2010 sentiment track, TREC 2011 microblog track, ROMIP 2011). To date it has been applied to French, Spanish, English, Mandarin Chinese and Russian.

Acquisition of Monolingual Units and Automatic Paraphrasing

Various natural language expressions may express similar or related meanings in context, which represents a major difficulty for NLP applications, as manually built resources are limited in availability and coverage. The ILES group develops techniques for the acquisition and use of related monolingual units.

A number of resources of related sentence pairs have been studied in terms of how many and what sub-sentential paraphrases may be acquired from such corpora (Bouamor et al., 2012b), including sub-sentential rewritings from Wikipedia's revision history (Dutrey et al., 2011). A variety of representative individual techniques have been tested (Bouamor et al., 2010), and new approaches based on edit rate computation (Bouamor et al., 2011a) and automatic validation (Bouamor et al., 2012a) have been developed and evaluated on French and English (see also Bouamor, PhD 2012).

Once sub-sentential paraphrases are available, they can be used to improve the performance of various NLP tasks. The work of the ILES group has for instance shown that such paraphrases can provide efficient authoring aids by validating paraphrasing in the context of a text (Bouamor et al., 2011b), and by improving the performance of Statistical Machine Translation systems by considering contextually suitable paraphrases as additional training examples (Max, 2010).

Paraphrases can be sought across two different types of discourse, for instance between texts intended for specialists and texts intended for lay people. (Deléger & Zweigenbaum, 2010) showed how to acquire such correspondences through pre-defined morpho-syntactic transformation patterns; recent extensions showed how to discover such patterns from the data.

Acquisition of Bilingual Units and Automatic Rewriting Across Languages

NLP systems need access to resources describing equivalences across languages (bilingual pairs of words, terms, segments, rules, etc.), in order to provide access to information available in foreign languages and to automatically transform some text into an equivalent text in another language.

In the ANR Chronolines project, important events are identified in comparable news stories in French and English. Corpora in the two languages are simultaneously used to improve identification, giving more importance to events frequently found in both languages. Work has also been conducted on the construction of weighted event lexicons (Arnulphy et al., 2012), initially with rules built on French and later ported to English by rule and lexicon entry translation, weighted according to the likelihood that they correspond to events. The above-mentioned work on medical entity annotation (Ben Abacha et al., 2012) also produces useful bilingual units in the form of pairs of English and French medical entities.

Research on Statistical Machine Translation is also conducted in ILES in collaboration with the related activity in the TLP group. Work has notably been conducted on local lexical adaptation from complementary sources (Crego et al., 2010; Leusch et al., 2010), use of paraphrasing in translation (Max, 2010), and contrastive translation evaluation (Max et al., 2010). The use of automatically acquired term pairs to improve Statistical Machine Translation has also been investigated with CEA LIST (Bouamor D. et al., 2011).

Topic 3: Information Extraction, Focused Information Retrieval, and Question-Answering

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Billions of digital textual documents are now available on-line on the Web and inside organisations. Accessing relevant information in such a wealth of unstructured documents is one of the present challenges of computer science. Therefore a large part of the activity in the ILES group is dedicated to this topic. This includes information extraction (spotting targeted information in texts), focused information retrieval (locating target information in documents to answer a query), and more specifically question-answering (finding precise information in texts to answer natural language questions). These methods complement mainstream information retrieval techniques, whose main goal is document retrieval, by putting more emphasis on a precise analysis of text contents. This activity also provides a test-bed for methods designed in the other ILES research topics, such as representation and paraphrasing.

This is a long-running topic in the ILES group, where it has gained visibility by obtaining good positions in international challenges (TREC, CLEF, i2b2). This has afforded the group a BQR assistant professor position for 2012 and a CR1 CNRS researcher recruitment, also in 2012.

Text Analysis Methods for Information Extraction

Building a representation from natural language texts is the core part of this research topic, therefore it motivates a large share of our activity. While successful text analysis for information access depends on a complex combination of intertwined methods, we highlight here specific points that we have been addressing.

Contemporary information extraction methods are often based on surface clues; we examine how various levels of syntactic processing help information extraction. At the most basic level, lexico-syntactic extraction patterns, often using semantic classes, are useful abstractions to detect entities (Deléger et al., 2010) and relations (Ben Abacha & Zweigenbaum, 2011). Instead of tackling the full complexity of syntactic analysis, syntactic simplification (Zhu et al., 2010) can be an efficient tactic to make it easier for relation extraction algorithms to cope with initially complex sentences (Minard et al., 2011). Tense and aspect are obviously important clues for temporal expression analysis and normalization (Kessler et al., 2012). Parse trees can be used in machine learning algorithms by breaking them down into elementary trees, used as features for relation extraction or opinion detection (Pak et al., 2012). In question-answering, syntactic analysis builds a more structured representation of questions or passages and helps match answers to questions more precisely (Moriceau & Tannier, 2010).

Relevant information is often spread across multiple sentences or even across multiple documents. We address multi-sentence processing through co-reference resolution, for which we took part in the i2b2 2011 challenge, together with TLP members, and obtained the best results for an end-to-end entity recognition and (expert-based) co-reference resolution system. This line of work further sparkled a collaboration with FBK (Trento), who sent an FBK PhD student for a three-month stay at LIMSI in spring 2012 to design a machine-learning-based co-reference system. It will also be the topic of a similar collaboration with MIT, sending an MIT PhD student for a nine-month stay at LIMSI starting in September 2012 under a Châteaubriand fellowship to work on bilingual transfer of co-reference resolution. At another level, we work on temporal analysis and reasoning to follow up events in and across news stories and build timelines (Kessler et al., 2012). In yet another dimension, reasoning across documents is also useful to validate answers to questions, finding and correlating information elements that together confirm the full selected answer (Moriceau & Tannier, 2010).

In this reporting period we have increased our use and knowledge of supervised machine learning (ML) methods. Given our expertise, our role in this context has been to model the input material (texts, sentences, phrases, words) with suitable features rather than to develop new ML algorithms. This part of the work is generally given low priority in ML venues, but is indeed of utmost importance in a domain where input data displays complex structure and properties. For the present time, feature engineering is more an art than a science, and we are incrementally building up know-how that we hope to convert into principles as we become more knowledgeable. We are also trying to understand better when and where machine learning can help and when on the contrary expert-based methods are more suitable. Combining expert-based and machine-learning-based methods into hybrid methods is a related line of investigation that we are exploring (Minard et al., 2011, Abacha & Zweigenbaum, 2011): the number of training examples for each class is obviously an important parameter to determine which approach is likely to be more efficient. Given the rarity and sparsity of annotated corpora for machine learning, less supervised methods are a highly interesting alternative. Weakly supervised or semi-supervised methods take advantage of external knowledge to find examples in an unannotated corpus, for instance for relation extraction (Ben Abacha & Zweigenbaum, 2011) or semantic role labelling (Mouton, PhD 2010). Unsupervised methods draw on very large unannotated corpora to collect knowledge, for instance on relations (Wang et al., 2011). The arrival of a machine learning specialist in the ILES group in Fall 2012 should strengthen this whole line of research.

Levels of Information Extraction

Information aims at spotting different types of target elements in texts. We list below those we address.

Named Entities (names of persons, locations, organisations, etc.) are the basic information units that generally need to be extracted. On the one hand we have extended these general entity types (see Corpora and Representations). On the other hand we have addressed various entity types relevant in specialized texts, including biological texts and patents (Galibert et al., 2010ab), medical texts (Deléger et al., 2010; Minard et al., 2011), including those necessary to anonymise clinical texts (Grouin & Zweigenbaum, 2011). Strategies to detect entity frontiers and types separately or jointly have been investigated (Ben Abacha & Zweigenbaum, BioNLP 2011).

Negation and modality provide information on the factuality of the detected entities (Bernhard and

Ligozat, 2011).

Relations link entities and provide structure to the extracted representation. Among the methods we tested for relation extraction are syntactic simplification of input representations and hybrid methods (Minard et al., 2011).

Event descriptions are important building blocks for higher-level text representation, for instance taking the form of ordered events on a chronological axis. However, events are, in open-domain information extraction, less studied than general named entities such as the names of persons and locations. We focus our work on nominal forms of events, which we call "event named entities". We have designed methods to build lexicons of event names and automatically extract names of events in texts (Arnulphy et al., 2010; Arnulphy et al., 2011).

Temporal information further provides a higher-level structure to a document or document collection. Our aim in the Chronolines project is to build thematic timelines for a general domain topic defined by a user query. The majority of systems designed to tackle this task handle textual information with a bag-of-words approach. They use little temporal information, generally only obtained from document metadata, such as the document creation time. We distinguish our work from that of previous researchers in that we have focused primarily on extracted temporal information as opposed to other textual content. We have showed that using linguistic temporal processing together with classical machine learning techniques helps extract important events in texts (Kessler et al., 2012).

Opinions and sentiments contribute another dimension of the information conveyed by texts. In opinion mining, the two main trends nowadays are machine-learning- and lexicon-based approaches. For the latter, the availability, extent and quality of the opinion/sentiment lexicon are essential. (Pak & Paroubek, TALN 2010) hence proposed a language-independent, automatic approach to build sentiment lexicons from microblogs and social media, by combining word salience, meta data and emoticons (see also Pak, PhD 2012). Opinion mining is also addressed in the PhD thesis of M. Marchand co-supervised with CEA/LIST.

Beyond surface representations

Information extraction, focused search and question answering often rely on bags of words or terms or entities to find relevant information. We have pointed out earlier that more advanced clues can be useful for information extraction, and mentioned how syntax-based representations can help match questions and passages and extract relevant answers, including across multiple documents (Moriceau & Tannier, 2010).

A symbolic, ontology-based representation is necessary in some tasks. To detect and represent user requirements in a form that will enable reasoning, (Sadoun et al., 2011) use an ontology of the target domain. In this context, ontology-based information extraction drives ontology population. (Burgun et al., 2011) project the results of an initial information extraction step to a task-specific ontology to compute a score that assesses the level of risk of a patient in cardiology. (Ben Abacha, PhD 2012) represents the relations between entities detected in questions and in text passages as RDF triples. She then designs SPARQL queries, with several levels of relaxation, to find answers to the questions.

Reasoning on the compatibility of the semantic type of an answer and that expected by a question is an important step in question answering. This is best effected as an answer validation step after candidate answers are collected (Grappy & Grau, 2011; Grappy, PhD 2011).

Topics in a text collection may be represented as graphs of weighted terms which to represent a domain or a document. Graphs of terms and documents also help design algorithms to build a specialized corpus. These graphs support Pagerank-style algorithms to weight terms and/or documents, and can be used in a vertical search engine to build the search collection and to perform query expansion (de Groc, 2011; de Groc et al., 2011).

Connection to other ILES themes

Most of the work described in this section applies to French or English, often with a multilingual dimension, e.g. designing methods on one language and transferring them to another, or designing cross-language search methods. Please see section *Multilingualism and Paraphrasing* on this topic.

A large part of this work has been evaluated through our participation in national and international challenges. In many instances, we also designed internal development or test corpora, or collaborated to or coordinated the design of the challenges (Quintard et al., 2010; Galibert et al., 2010, 2011; Beckers et al., 2010 ; Alexander et al., 2011). Please see section *Corpora and Representations* on this topic.

Topic 4: Sign Language Modelling and Processing

__A. Braffort__, L. Bolot, A. Choisier, M. Filhol, C. Verrecchia; PhD students: É. Chételat, M. Delorme, J. Segouat. Annotators: F. Badin, N. Devos

Sign languages (SL) are natural languages used by the deaf, and some hearing people alongside the deaf. These languages are classified as visual-gestural (issued by the body and received through vision). They are expressed in space, in front of the speaker, by means of gestural units composed of hand and arm gestures, chest, shoulders or head movements, facial expressions, gaze directions, etc., that are carried out simultaneously.

As with spoken languages, there is no one universal SL. Rather, there exist as many variations as there are different deaf communities, each with its own SL history, signifying units and lexicon. However, unlike speakers of two different spoken languages, two deaf people operating in two different SL may come to understand each other and communicate in a very short time. This is due to the close proximity of linguistic structures between SL: certain very iconic are characterized by the absence of so-called "standard" signs (each of them different for each language). The provenance of these shared structures is probably the very nature of the channel and its propinquity to the mental representations of deaf speakers. What we often refer to as "visual thinking" challenges conventional perceptions of what belongs to the field of linguistics.

SL, because they have no writing system, are eminently oral. This all the more strongly differentiates them from spoken languages: SL are gestural rather than vocal, and, with no writing system, are uniquely oral. One of the main reasons for the difficulty of creating or borrowing a written form for use in SL lies in their modality: SL exist within space and time, through gestures, postures, mimicry and gaze, all meaningful and potentially simultaneous. This languages' mode of expression is therefore multilinear and multidimensional. By contrast, the ensemble of human writing follows from the (mono)linearity of spoken languages. Currently, no graphics technology makes it possible to provide SL with the primary and daily functions of writing (e.g. recording, note-taking on the fly, linear reading), even if video is sometimes used to fill some of these roles. The only form of writing available to the deaf is generally that of the spoken languages of the country where they live. But the majority of the profoundly deaf do not read and write well enough to access a high level of education and training, to access a writing-based means of communication, or to even assume their role as citizens. These facts hinder their professional and personal development. This need has generated an interest among researchers in Sign Language Processing, which would include elements of recognition, generation and machine translation. This research relies on corpus analysis, principally video.

The theme *Sign Language Modelling and Processing* concerns the study of sign languages, according to three complementary aspects: corpus, modelling and generation.

Sign Language Corpora

SL are less-resourced languages. Indeed, they have access to too few of the resources, and in some cases none at all, that are commonly available to other languages. Specifically, this includes a writing system, reference books describing a language's operation (grammars, dictionaries), mass publishing and distribution, technical and learning books, communication media of everyday life, as well as computer applications in that language. Similarly, the corpora, which are the only way to establish and maintain a permanent patrimonial record in sign language, are few and small-scale. Technological advances in video capture, storage and handling have recently enabled the initiation of several projects to create SL corpora, even multilingual corpora, in different countries.

We participate to the gathering of French Sign Language corpora, and develop methodologies for gathering (elicitation), annotation (qualitative and quantitative), and analysis.

Recently, we have created two corpora:

- In 2010, the LSF part (8 hours of dialogue) of the corpus produced within the Dicta-Sign European project, in collaboration with IRIT lab and WebSourd company. This corpus has been annotated is currently used for a cross-linguistic analysis of some linguistic structures in the four SL of the project (French, German, Greek and English).
- In 2011, the DEGELS1 corpus, a comparable corpus of French Sign Language and co-speech gestures that has been created to serve as a test-bed corpus for the DEGELS workshops, in collaboration with the LPL lab. These workshop series were initiated in France for researchers studying French Sign Language and co-speech gestures in French, with the aim of comparing methodologies for corpus annotation. Extracts of this corpus have been annotated by several teams participating in these

events.

and conducted two studies related to annotation methodologies:

- A study on non-manual components: Emilie Chételat's PhD thesis on eyebrow movements and blinking.
- A study on co-articulation phenomena: Jérémie Segouat's PhD thesis in collaboration with the WebSourd Company.

We are now initiating a study of a parallel corpus of written French and LSF, the WebSourd corpus, which consists of brief news that are translated each day by the deaf translators of the WebSourd company.
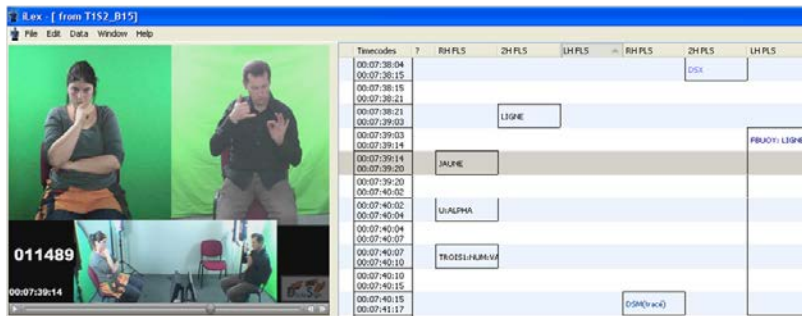
Illustration 3 - Setting up of the Dicta-Sign corpus studio, extract of an annotation of the Dicta-Sign corpus using the iLex annotation software.

Sign Language Modelling

Part of the Natural Language Processing (NLP) field of Artificial Intelligence, the goal of Sign Language modelling is to build formal representations and tools the represent how the sign languages operate and that will be usable in analysis, recognition or generation software.

Formal approaches to representing the signs of Sign Languages are traditionally parametric. Their main drawbacks are that the parameters used are neither all necessary nor do they form a sufficient set; parameters take on fixed values whereas signs are dynamic in nature and values change through time; parametric descriptions do not account for the signs' adaptability to context, hence are not reusable, which brings them to disregard the power in concision of sign languages. At the utterance level, the traditional approaches are based on HPSG grammars. These grammars are not able to represent the tremendously complex articulation and synchronisation system of SL. Thus we developed new models, based on corpus observation and analysis.

Recently, we have conducted two studies related to formal representation:

- A study on lexicon representation: Michael Filhol's PhD thesis on Zebedee, a new model that describes signs in a sequence of timing units, each of which specifies a set of necessary and sufficient constraints to apply to a skeleton. The signing space is regarded as a Euclidean geometric space where auxiliary geometric objects may be built. Dependencies between elements of the descriptions or indeed on contextual elements are not only possible but also made relevant, hence the descriptions account for the iconic nature of signs. "Zebedescriptions" are based on articulatory, semantic and cognitive issues, not only on the observation of a single context-free utterance, which proves to be difficult to reuse.

Zebedee's coverage capacity was evaluated on a corpus of 1500 lexemes during the Dicta-Sign project.

- A study on the synchronisation of the set of articulators used in SL utterances. This gave birth to the Azalee synchronisation formalism, which has been initiated during the Dicta-Sign project and is still under development.

Current studies:

- Zebedee and Azalee, each accounting for a specific synchronisation mode, can be combined to form the AZee model, still under construction and evaluation, which will allow us to represent complete SL utterances.
- We have recently started an exploratory work on automatic translation, from text to Sign Language.
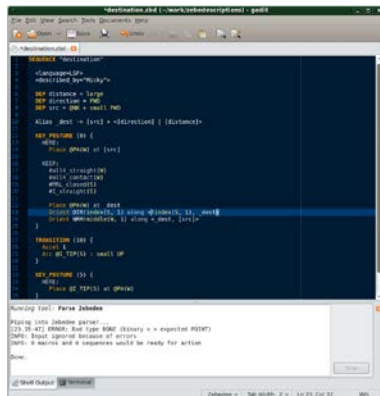
Illustration 4 - Zebedee editor

Sign Language Generation

The assessment of representations goes through their implementation in software platforms, in our case that is automatic generation. Automatic generation of SL utterances is visualized by the animation of a virtual signer (humanoid in 3 dimensions).

Recently, we have conducted three studies related to automatic and computer-assisted generation:

- Toward automatic generation, a study on zebedescription solving and skeleton modelling: Maxime Demorme's PhD thesis. From a description in the Zebedee format, we need automatically to output the acceptable postures (and then full animations therefrom), which constitutes a constraint solving problem with several types of constraints combined:

    o linguistic constraints, from the zebedescriptions;
    o rigid articulatory constraints, from the physiological properties of the skeleton to be animated;
    o more flexible bio-mechanical constraints to choose the most appropriate (comfortable?) posture, as many are usually acceptable for the same input.

- Two studies on computer-assisted generation, by using animation presets created by a computer graphic designer using rotoscoping techniques within two kinds of platforms:

    - The Octopus platform, which allows animations to be concatenated and co-articulated to form 3d utterances. This approach allows us to generate very realistic SL utterances and has been used in a real application used by the SNCF railway company, by the way of a collaboration with the WebSourd company.

    - The Diva platform, in collaboration with the AMI group, which is designed for the web, to be concatenated to form 2.5d utterances.

Illustration 5 - Sign language generation using Octopus in Gare de l'Est railway station in Paris

- During the period, the group recruited two CNRS researchers (2010 and 2012), one assistant professor on a BQR competitive project (2012), and obtained a Senior Researcher promotion (2011).
- Repeated efforts to submit high-quality project proposals in the present period have succeeded in obtaining new project grants, including one European project (Chist'Era uComp, to begin in Fall 2012), two ANR ContInt (Chronolines, 2011-2014 ; Accordys, 2012-2015), one FUI 13 (ProjEstimate, 2012-2015), and one Digiteo project (Envie Verte, 2010-2013), as well as three LIMSI-funded "Actions incitatives". Notable is the fact that new teams and consortia are contacting us, based on our known skills, to submit excellent project proposals (e.g., uComp and ProjEstimate).
- The sign language activity, which was merged with the natural language processing activity to form the ILES group at the end of 2008, has taken strong ground with the recruitment of a CNRS researcher and the completion of a European project. Links between sign language and written language processing are entertained in ILES in the study of corpora and lexicons, and are strengthening through a LIMSI-supported project which explores translation from written language to sign language , starting with the expression of time in a parallel corpus of AFP news in LSF and written French.
- The biomedical domain has taken momentum among the application domains addressed in information extraction and question-answering. On the one hand, the two PhD theses of A Ben Abacha and AL Minard addressed this domain; on the other hand, we took part in the international i2b2 challenge on information extraction from clinical texts, each year with a reconfigured team which reached 10 people in 2010, ranking in the top 10 for most tasks (#3 for relation extraction in 2010 and #1 for end-to-end co-reference resolution in 2011). This helped us obtain the BQR assistant professor position and attracted solicitations from foreign colleagues to host PhD student internships on this topic.
- The paraphrasing and translation activity has obtained publications in the top international conferences of the domain (EMNLP 2010, COLING 2010, ACL short 2011 and 2012) and produced corpora that are distributed online. It has also attracted a Japanese colleague specialized in sentence simplification, who will come for a sabbatical year in September 2012.
- Best system on the 5-class track on Russian sentiment classification at ROMIP 2011 evaluation

Staff

Permanent Staff

Firstname	Lastname	Type of position	Employer	HDR	Arrival date	Departure date
Cécile	Balkanski	Ass. Prof.	U-PSud			
Laurence	Bolot	Res. Eng.	CNRS			
Annelies	Braffort	DR	CNRS	HDR		
Annick	Choisier	Res. Eng.	CNRS			
Michael	Filhol	CR	CNRS		Hired as of 01/10/2010	
Brigitte	Grau	Prof.	ENSIIE	HDR		
Cyril	Grouin	Res. Eng.	CNRS			
Martine	Hurault-Plantet	Res. Eng.	CNRS			Retired on 10/09/2010
Gabriel	Illouz	Ass. Prof.	U-PSud			
Anne-Laure	Ligozat	Ass. Prof.	ENSIIE			
Aurélien	Max	Ass. Prof.	U-PSud			
Véronique	Moriceau	Ass. Prof.	U-PSud			
Patrick	Paroubek	Res. Eng.	CNRS			
Isabelle	Robba	Ass. Prof.	UVSQ			
Xavier	Tannier	Ass. Prof.	U-PSud			
Cyril	Verrecchia	Ass. Eng.	CNRS			
Anne	Vilnat	Prof.	U-PSud	HDR		
Pierre	Zweigenbaum	DR Researcher	CNRS	HDR		

PhD Students

Firstname	Lastname	Graduate school	University	Type of support	Start date	Date of defense
Béatrice	Arnulphy	EDIPS	U-PSud	CDD CNRS QUAERO	01/10/2008	
Asma	Ben Abacha	EDIPS	U-PSud	U-PSud PhD grant	01/10/2008	28/06/2012
Houda	Bouamor	EDIPS	U-PSud	MNRT PhD grant	06/10/2008	11/06/2012
Emilie	Chetelat	EDIPS	Aix en Provence	MNRT PhD grant	01/03/2007	25/03/2010
Clément	De Groc	EDIPS	U-PSud	CIFRE/CDD Syllabs	18/11/2009	
Thierry	Delbecque	EDIPS	U-PSud	CDI	01/12/2006	
Maxime	Delorme	EDIPS	U-PSud	MNRT PhD grant	01/10/2008	07/12/2011
Camille	Dutrey	EDIPS	U-PSud	CIFRE/CDD EDF	06/12/2011	
Mathieu-Henri	Falco	EDIPS	U-PSud	U-PSud PhD grant	01/10/2010	
Anne	Garcia Fernandez	EDIPS	U-PSud	MNRT PhD grant	01/10/2006	10/12/2010
Arnaud	Grappy	EDIPS	U-PSud	MNRT PhD grant	01/10/2007	08/11/2011
Morgane	Marchand	EDIPS	U-PSud	CDD CEA	05/12/2011	
Anne-Lyse	Minard	EDIPS	U-PSud	U-PSud PhD grant	01/10/2009	
Claire	Mouton	EDIPS	U-PSud	CIFRE/CDD CEA	01/11/2007	17/12/2010
Alexander	Pak	EDIPS	U-PSud	CDD CNRS DOXA PROJECT	01/09/2009	13/06/2012
Driss	Sadoun	EDIPS	U-PSud	CDD CNRS DIGITEO	01/10/2010	
Jérémie	Segouat	EDIPS	U-PSud	CIFRE/CDD WEBSOURD	01/12/2007	15/12/2010

Non permanent staff

Firstname	Lastname	Type of position	Employer	Arrival date	Departure date
Pierre	Albert	Post-Doc	CNRS	01/12/2009	31/12/2011
Flora	Badin	Post-Doc	CNRS	01/10/2009	30/09/2010
Caroline	Benoit	Post-Doc	CNRS	01/11/2009	30/11/2011
Delphine	Bernhard	Post-Doc	CNRS	01/10/2009	30/09/2011
Louise	Deleger	Post-Doc	CNRS	01/12/2009	31/12/2010
Nadège	Devos	Post-Doc	CNRS	01/10/2009	30/09/2011
Mathieu	Falco	Post-Doc	CNRS	01/10/2009	30/09/2010
Michael	Filhol	Post-Doc	CNRS	01/09/2009	30/09/2010
Anne	Garcia Fernandez	Post-Doc	CNRS	01/09/2010	31/12/2010
Remy	Kessler	Post-Doc	CNRS	01/09/2011	31/08/2012
Noureddine	Mokhtari	Post-Doc	CNRS	01/01/2011	31/12/2011
Clarine	Tranchant	Post-Doc	CNRS	15/06/2011	14/08/2011

Indicators of scientific notoriety

Editorial board appointment

- B. Grau, RSTI-Document numérique, editorial board member
- B. Grau, RSTI-Technique et Science Informatiques, editorial board member
- P. Paroubek, Hermes-Lavoisier's Language and technology series, series editor
- P. Paroubek, Traitement automatique des langues, editorial board member
- P. Zweigenbaum, Cahiers du CENTAL book series, editorial board member
- P. Zweigenbaum, Terminology, editorial board member
- P. Zweigenbaum, Traitement automatique des langues, editorial board member
- P. Zweigenbaum, RSTI-Revue d'intelligence artificielle, editorial board member
- P. Zweigenbaum, Information - Interaction – Intelligence, editorial board member

Organization of international or national scientific events

Member of the scientific, technical program and/or organizational committees for international/national conferences or workshops

- A. Braffort, co-chair of Workshop Degels at TALN 2011 and TALN 2012

- A. Braffort, co-chair of ATALA Tutorial day on Video corpus annotation, 2011
- B. Grau, chair of CORIA 2010
- B. Grau, chair of Fall school on Information Retrieval EARIA 2012
- C. Grouin, co-chair of Workshop DEFT at TALN 2010
- C. Grouin, chair of Workshop DEFT at TALN 2011 and TALN 2012
- V. Moriceau, X. Tannier, co-chair of INEX QA Task 2010 and 2011
- V. Moriceau, X. Tannier, co-chair of CLEF/INEX Tweet Contextualization Task 2012
- P. Zweigenbaum, co-chair of the workshop on Building and Using Comparable Corpora at LREC 2010
- P. Zweigenbaum, chair of the workshop on Building and Using Comparable Corpora at ACL 2011
- P. Zweigenbaum, co-chair of the workshop on Building and Using Comparable Corpora at LREC 2012
- P. Zweigenbaum, co-chair of the Int. Conf. on Terminology and Artificial Intelligence (TIA 2011)

Member of programme committee in international conferences and workshops:

- B. Grau, Poster Program Committee of conference SIGIR 2010, SIGR 2011 and SIGR 2012
- B. Grau, P. Zweigenbaum, Program Committee of workshop Text Mining and Applications (EPIA 2011)
- A. Max, Program Committee of conference EAMT 2010
- A. Max, Program Committee of Workshop on Innovative Use of NLP for Building Educational Applications (ACL 2011)
- A. Max, Program Committee of Workshop on Innovative Use of NLP for Building Educational Applications (NAACL 2012)
- A. Max, Program Committee of Workshop on Computational Linguistics and Writing (NAACL 2010)
- A. Max, Program Committee of Workshop on Computational Linguistics and Writing (EACL 2012)
- A. Max, Program Committee of Joint Workshop on Statistical Parsing and Semantic Processing of Morphologically-Rich Languages (ACL 2012)
- A. Max, Program Committee of Workshop on Natural Language Processing for Improving Textual Accessibility (LREC 2012)
- A. Max, Program Committee of Workshop on Syntax, Semantics and Structure in Statistical Translation (ACL 2011)
- V. Moriceau, Program Committee of Workshop on Constraints Solving and Language Processing (CSLP2011)
- V. Moriceau, Program Committee of Workshop on Constraints Solving and Language Processing (CSLP2012)
- P. Paroubek, Program Committee of the Language and Technology Conference LTC 2011
- P. Paroubek, Program Committee of SIGDIAL 2011
- P. Paroubek, P. Zweigenbaum, program committee of Workshop DEFT at TALN 2010, TALN 2011 and TALN 2012
- A. Vilnat, P. Zweigenbaum, Program Committee of conference TALN 2010
- P. Zweigenbaum, Program Committee of workshop on Biomedical NLP (ACL 2011)
- P. Zweigenbaum, Program Committee of conference Artificial Intelligence in Medicine Europe, 2011
- P. Zweigenbaum, Program Committee of BioNLP Shared Task (ACL 2011)
- P. Zweigenbaum, Program Committee of workshop Cognitive Aspects of the Lexicon (COLING 2010)
- P. Zweigenbaum, Program Committee of Journées francophones d'informatique médicale, 2011
- P. Zweigenbaum, Program Committee of conference Languages in Biology and Medicine, 2011
- P. Zweigenbaum, Program Committee of workshop LOUHI (NAACL 2010)
- P. Zweigenbaum, Program Committee of workshop LOUHI (AIME 2011)
- P. Zweigenbaum, Program Committee of workshop NETTAB 2011
- P. Zweigenbaum, Program Committee of conference RIAO 2010
- P. Zweigenbaum, Program Committee of conference Semantic Mining in Biomedicine, 2010
- P. Zweigenbaum, Program Committee of conference Semantic Mining in Biomedicine, 2012
- P. Zweigenbaum, Program Committee of International Workshop on Lexical Resources (ESSLLI 2011)

Member of programme committee in national conferences and workshops:

- A. Braffort, Program committee of DEGELS workshop 2011 and 2012
- B. Grau, AL. Ligozat, P. Zweigenbaum, Program Committee of conference CORIA 2010
- B. Grau, P. Zweigenbaum, Program Committee of conference CORIA 2011
- B. Grau, AL. Ligozat, P. Zweigenbaum, Program Committee of conference CORIA 2012
- B. Grau, P. Zweigenbaum, Program Committee of workshop RISE (INFORSID 2010)
- B. Grau, P. Zweigenbaum, Program Committee of workshop RISE (CORIA 2011)
- B. Grau, P. Zweigenbaum, Program Committee of workshop RISE (EGC 2012)
- B. Grau, P. Zweigenbaum, Program Committee of Symposium sur l'ingénierie de l'information médicale, 2011
- A. Vilnat, P. Zweigenbaum, Program Committee of conference TALN 2011
- A. Vilnat, P. Zweigenbaum, Program Committee of conference TALN 2012
- P. Zweigenbaum, Program Committee of conference RFIA 2012

Invited lectures, talks or seminars

Invited workshop speaker

- P. Zweigenbaum. Building and acquiring resources for biomedical language processing. In Second Workshop on Building and Evaluating Resources for Biomedical Text Mining, Valetta, Malta, 2010. ELDA.
- P. Zweigenbaum, Traitement automatique de textes cliniques : le cas du français. In Symposium sur l'ingénierie de l'information médicale, June 2011, Toulouse

Tutorial at workshops or conferences or summer schools

- X. Tannier, École d'Automne en Recherche d'Information et Application (EARIA 2010)
- P. Zweigenbaum, NETTAB 2011, Pavia

Invited talk (national or international)

- M. Filhol, Institut of German Sign Language and Communication of the Deaf, Univ. of Hamburg, 2011
- B. Grau, CEA, Bruyères Le Chatel, 2012
- A. Max, LORIA, Nancy, 2010
- P. Zweigenbaum, Fondazione Bruno Kessler, Trento, 2010
- P. Zweigenbaum, Kasetsart University, Bangkok, 2010
- P. Zweigenbaum, Langues et Civilisations d'Asie Orientale Seminar, Paris Diderot University
- P. Zweigenbaum, Université Stendhal, Grenoble, 2010

Participation in expertise and administration of research

International or national scientific networking

International networks

- P. Zweigenbaum, WP3 leader in T4ME European Network of Excellence (2011-2012)

National networks or working groups

- C. Grouin, Board Member of ATALA (2011-)
- P. Paroubek, Vice-President of ATALA
- A. Vilnat, Vice-President of ATALA
- A. Vilnat, member of Standing committee of the national TALN conference (-2012)
- P. Zweigenbaum, chair of Standing committee of the national TALN conference (-2012)

Participation in evaluation or expertise committees

National committees (CoNRS, CNU, CCSU…)

- P. Zweigenbaum : Chair of CID 44 in CoNRS

Expert for scientific evaluation committees

- A. Braffort, ANR Corpus 2012
- A. Braffort, A. Max, P. Zweigenbaum, ANR Blanc International SIMI2 2012
- A. Braffort, ECOS-NORD 2011 and 2012
- P. Paroubek, member of AERES Visiting committee 2010 (GREYC)
- A. Vilnat, member of DIM (Regional Program) evaluation committee 2010
- A. Vilnat, member of ANR ContInt Evaluation committee 2011
- A. Vilnat, member of Digiteo Evaluation committee 2011
- A. Vilnat, ANR ASTRID 2011
- P. Zweigenbaum, member of AERES Visiting committee 2012 (LORIA)
- P. Zweigenbaum, member of ANR Blanc/JCJC Evaluation committee 2010
- P. Zweigenbaum, member of Corpus follow-up committee 2011
- P. Zweigenbaum, member of TecSan Evaluation committee 2012
- P. Zweigenbaum, member of PRST MISN Evaluation committee (LORIA, 2010-2012)
- P. Zweigenbaum, Fonds national suisse (FNS) 2010
- P. Zweigenbaum, Netherlands Organization for Scientific Research (NWO) 2012
- P. Zweigenbaum, Brittany PhD fellowships (ARED) 2010
- P. Zweigenbaum, BQR Paris-Nord University 2010Member of the administration or advisory board

Member of the administration or advisory board

- P. Zweigenbaum, board member, Department of Linguistics, Paris Diderot University

Member of selection juries

- A. Braffort, Aix-Marseille University, MCF 0569
- B. Grau, Caen University, PR 2012
- A. Max, Paris-Nord University, MCF 2011, 2012
- V. Moriceau, Paris-Sud University, MCF 2012
- X. Tannier, Paris-Sud University, MCF 2011
- X. Tannier, Grenoble Stendhal University, MCF 2011
- A. Vilnat, co-chair, Paris-Sud University, CCSU
- A. Vilnat, chair, Paris-Sud University, PR 2010, 2011 and 2012
- A. Vilnat, Paris-Nord University, MCF 2011
- A. Vilnat, Montpellier University, MC and PR 2010, PR 2011
- A. Vilnat, Nantes University MC 2012
- A. Vilnat, Cemagref CR, 2011
- P. Zweigenbaum, Paris-Nord University, MCF & PR 2012
- P. Zweigenbaum, chair, Inalco, PR 2010
- P. Zweigenbaum, Caen University, MCF & PR 2011
- P. Zweigenbaum, Lille University, PR 2011
- P. Zweigenbaum, Rouen University, MCF 2012
- P. Zweigenbaum, Toulouse Paul Sabatier University, MCF 2010
- P. Zweigenbaum, Toulouse Le Mirail University, PR 2011

Teaching activities and duties in relation to research

- B. Grau, C. Grouin, AL. Ligozat, A. Max, V. Moriceau, X. Tannier, P. Paroubek, A. Vilnat, P. Zweigenbaum, courses on Natural Language Processing and Information Retrieval, Master 2 level, Paris Sud University, ENSIIE, Inalco, UPMC
- Numerous PhD and HDR juries, including rapporteur and president, in computer science, linguistics, and medical informatics, including abroad

Dissemination and vulgarization

- M. Filhol, Journée de sensibilisation Handicap Auditif, Paris-Sud University, 2011
- A. Max, Machine Translation: Fête de la Science, Paris-Sud University, 2011
- C. Grouin, P. Zweigenbaum, Distributed Named Entity corpora: Digiteo highlights 2011
- X. Tannier, Protection on Internet: France 2 (2010), France Bleu (2010), computer science magazines, general audience magazines (Le Particulier, etc., women's Web sites) in 2010, 2011, 2012.

Research conventions and contracts

Valorization

- WebAnnotator (online corpus annotation tool), Medina (anonymization of clinical texts), Quaero structured named entity corpora, Apetite (tools for temporal annotation of texts), WiCoPaCo (Wikipedia Correction and Paraphrase Corpus)

Industrial relationships

- Long-term relationships are established with companies through CIFRE PhD theses (Exalead: C. Mouton, Syllabs: C de Groc) and co-supervised PhD theses (CEA: D. Bouamor, M. Marchand, W. Wang), and through partnerships in funded projects (see list of ANR and FUI contracts below). ILES receives regular solicitations from companies to host CIFRE students or to join project proposals, including industrial FUI projects, which led to projects DOXA and ProjEstimate.

Contracts

Contract table

Acronym	Funding agency/Partner	Program	Nature	Resp. for LIMSI	General coordinator	Starting date	Ending date	LIMSI share
PASSAGE	ANR	MDCO	Research collab.	Paroubek P.	de La Clergerie E (Alpage).	01/01/2007	30/06/2010	155888
AKENATON	ANR	TecSan	Research collab.	Zweigenbaum P.	Burgun A.(LIM)	01/12/2007	30/05/2011	84106
Syntex software	Université de Toulouse Le Mirail		Licence	Vilnat A.	Vilnat A.	10/12/2007		
	Websourd	CIFRE	Research collab.	Braffort A.	Braffort A.	01/01/2008	31/12/2011	15000
InterSTIS	ANR	TecSan	Research collab.	Zweigenbaum P.	Forget Jean-F. (Vidal)	01/01/2008	30/12/2010	98762
C-MANTIC	ANR	MDCO	Research collab.	Zweigenbaum P.	Slodzian M. (ERTIM)	01/01/2008	31/12/2010	48533
QUAERO	OSEO		Research collab.	Gauvain J.-L.	Gauvain J.-L.	01/04/2008	31/12/2013	2993586
Lexical Data	CNRS	other	Licence	Vilnat A.	Vilnat A.	08/04/2008	07/04/2013	
	CEA	CIFRE	Research collab.	Vilnat A.	Vilnat A.	01/08/2008	30/07/2010	
XIP	XEROX		Licence	Vilnat A.	Vilnat A.	15/10/2008	15/10/2011	
DOXA	DGE	Competitiveness cluster		Paroubek P.	Gouttas C. (Thalès)	02/01/2009	01/01/2012	460213
Dicta-Sign	EU	STREP	EU contract	Braffort A.	Efthimiou E. (ILSP)	01/02/2009	31/01/2012	382156
FILTRAR-S	ANR	CSOSG	Research collab.	Grau B.	Campion N.	19/02/2009	18/08/2011	59565
DOXA-NDA	EDF	other	Non-disclosure agreem.	Paroubek P.	Paroubek P.	13/10/2009	12/10/2020	0
EDyLex	ANR	CONTINT	Research collab.	Adda G.	Sagot B. (Alpage)	01/11/2009	31/10/2012	181835
	Syllabs	PhD supervision	Research collab.	Zweigenbaum P.	Tannier X.	01/11/2009	31/12/2012	
i2b2 2010	i2b2		Licence	Grouin C.	Grouin C.	01/04/2010	31/03/2011	
	CEA	PhD supervision	Research collab.	Zweigenbaum P.	Zweigenbaum P.	01/09/2010	31/12/2013	
Envie Verte	Digiteo	Projet Emergent	Research collab.	Grau B.	Grau B.	01/09/2010	31/08/2013	110940
ChronoLines	ANR	CONTINT	Research collab.	Tannier X.	Battistelli D. (Modyco)	01/02/2011	30/11/2013	112073,8
i2b2 2011	UPMC		Licence	Grouin C.	Grouin C.	01/05/2011	30/04/2012	
	MyT		Research collab.	Vilnat A.	Vilnat A.	04/08/2011	03/02/2012	2000
	CEA	PhD supervision	Research collab.	Vilnat A.	Vilnat A.	01/09/2011	31/12/2014	

Scientific publications

Doctoral theses and HDR

T1. Chételat-Pelé, E., *Les gestes non manuels en langue des signes française. Annotation, analyse et formalisation : application aux mouvements des sourcils et aux clignements des yeux* 2010, thèse de l'Université Aix-Marseille. Soutenue à Aix en Provence, France, le 25 mars 2010, 212 p.

T2. Delorme, M., *Modélisation du squelette pour la génération réaliste de postures de la langue des signes française* 2011, thèse de l'Université Paris-Sud. Soutenue au LIMSI, Orsay, 7 décembre 2011, 166 p.

T3. Garcia-Fernandez, A., *Génération de réponses en langue naturelle orales et écrites pour les systèmes de question-réponse en domaine ouvert* 2010, thèse de l'Université Paris-Sud. Soutenue au LIMSI, Orsay, le 10 décembre 2010, 198 p.

T4. Grappy, A., *Validation de réponses dans un système de questions réponses* 2011, thèse de l'Université Paris-Sud. Soutenue au LIMSI, Orsay, le 8 novembre 2011, 166 p.

T5. Mouton, C., *Ressources et méthodes semi-supervisées pour l'analyse sémantique de texte en français* 2010, thèse de l'Université Paris-Sud. Soutenue au LIMSI, Orsay, le 17 décembre 2010, 249 p.

T6. Segouat, J., *Modélisation de la coarticulation en langue des signes française dans le contexte de la diffusion automatique d'informations en gare ferroviaire à l'aide d'un signeur virtuel* 2010, thèse de l'Université Paris-Sud. Soutenue au LIMSI, Orsay, le 15 décembre 2010, 212 p.

Articles in peer reviewed scientific journals

A1. Alexander, D., P. Arvola, T. Beckers, P. Bellot, T. Chappell, C. De Vries, A. Doucet, N. Fuhr, S. Geva, J. Kamps, G. Kazai, M. Koolen, S. Kutty, M. Landoni, V. Moriceau, R. Nayak, R. Nordlie, N. Pharo, E. SanJuan, R. Schenkel, A. Tagarelli, X. Tannier, J. Thom, A. Trotman, J. Vaino, Q. Wang, and C. Wu, *Report on INEX 2010.* SIGIR Forum, 2011. **45** (1): pp.2-17.

A2. Beckers, T., P. Bellot, G. Demartini, L. Denoyer, C. De Vries, A. Doucet, K. Fachry, N. Fuhr, P. Gallinari, S. Geva, W. Huang, T. Iofciu, J. Kamps, G. Kazai, M. Koolen, S. Kutty, M. Landoni, M. Lehtonen, V. Moriceau, R. Nayak, R. Nordlie, N. Pharo, E. SanJuan, R. Schenkel, X. Tannier, M. Theobald, J. Thom, A. Trotman, and A. De Vries, *Report on INEX 2009.* SIGIR Forum, 2010. **44** (1): pp.38-56.

A3. Ben Abacha, A. and P. Zweigenbaum, *Automatic extraction of semantic relations between medical entities: a rule based approach.* Journal of Biomedical Semantics, 2011. **2** (Suppl 5): pp.S4_1-S4_11.

A4. Bernhard, D., *Apprentissage non supervisé de familles morphologiques : comparaison de méthodes et aspects multilingues.* TAL (Traitement Automatique des Langues), 2010. **51** (2): pp.11-39.

A5. Berthelin, J.-B., *The DEFT Text-mining Challenge.* BULAG. Bulletin de Linguistique Appliquée et Générale, 2011. **35**: pp.49-61.

A6. Braffort, A., E. Chételat-Pelé, and J. Segouat, *Corpus de langue des signes : situer les biais des méthodes d'annotation et d'analyse.* CORPUS, 2011. **10**: pp.25-40.

A7. Braffort, A., J.-P. Sansonnet, J.-C. Martin, and C. Verrecchia, *Diva, une architecture pour le support des agents gestuels interactifs sur internet.* Technique et Science Informatiques, numéro spécial sur les Agents Conversationnels Animés, 2010. **29** (7): pp.777-806.

A8. Burgun, A., A. Rosier, L. Temal, J. Jacques, R. Messai, L. Duchemin, L. Deléger, C. Grouin, P. Van Hille, P. Zweigenbaum, R. Beuscart, D. Delerue, O. Dameron, P. Mabo, and C. Henry, *Aide à la décision en télécardiologie par une approche basée ontologie et centrée patient.* IRBM, 2011. **32** (3): pp.191-194.

A9. Crego, J.-M., G. Leusch, A. Max, H. Ney, and F. Yvon, *Micro-adaptation lexicale en traduction automatique statistique.* TAL (Traitement Automatique des Langues), 2010. **51** (2): pp.65-93.

A10. Deléger, L., C. Grouin, and P. Zweigenbaum, *Extracting medical information from narrative patient records: the case of medication-related information.* Journal of the American Medical Informatics Association - A scholarly journal of informatics in health and biomedicine, 2010. **17** (5): pp.555-558.

A11. Delorme, M., *Sign language synthesis: skeleton modelling for more realistic gestures.* ACM SIGACCESS Newsletter, 2010. (96): pp.19-23.

A12. Dutrey, C., H. Bouamor, D. Bernhard, and A. Max, *Local modifications and paraphrases in Wikipedia's revision history.* Revista de Procesamiento del Lenguaje Natural, 2011. **46**: pp.51-58.

A13. Grappy, A. and B. Grau, *Validation du type de la réponse dans un système de questions réponses.* Document Numérique, 2011. **14** (2): pp.125-147.

A14. Grouin, C. and P. Zweigenbaum, *Une approche à plusieurs étapes pour anonymiser des documents médicaux.* Revue d'Intelligence Artificielle (RIA), 2011. **25** (4): pp.525-549.

A15. Minard, A.-L., A.-L. Ligozat, A. Ben Abacha, D. Bernhard, B. Cartoni, L. Deléger, B. Grau, S. Rosset, P. Zweigenbaum, and C. Grouin, *Hybrid methods for improving information access in clinical documents: concept, assertion, and relation identification.* Journal of the American Medical Information Association (JAMIA), 2011. **18** (5): pp.588-593.

A16. Moriceau, V. and X. Tannier, *FIDJI: using syntax for validating answers in multiple documents.* Information Retrieval Journal, special issue on focused retrieval and result aggregation, 2010. **13** (5): pp.507-533.

A17. Pak, A. and P. Paroubek, *Le microblogage pour la microanalyse des sentiments et des opinions.* TAL (Traitement Automatique des Langues), 2010. **51** (3): pp.75-100.

A18. Segouat, J., A. Braffort, and A. Choisier, *Corpus de langue des signes : premières réflexions sur leur conception et leur représentativité.* Travaux du CerLiCO : l'exemple et le corpus, quel statut?, 2010. **23**: pp.77-94.

A19. Tannier, X. and P. Muller, *Evaluating Temporal Graphs Built from Texts via Transitive Reduction.* Journal of Artificial Intelligence Research, 2011. **40**: pp.375-413.

Books & chapters in books

B1. Grau, B., *Le texte, objet d'analyse et vecteur de connaissances*. Vol. 13/3. 2010: Hermes. 177p.

B2. Moriceau, V., E. SanJuan, X. Tannier, and P. Bellot, *Overview of the 2009 QA Track: Towards a Common task for QA, focused IR and automatic summarization systems*, in *Lecture Notes in Computer Science, Focused Retrieval and Evaluation, 8th International Workshop of the Initiative for the Evaluation of XML Retrieval, INEX 2009, Revised and Selected Papers, volume 6203*, S. Geva, J. Kamps, and A. Trotman, Eds. 2010, Springer. pp. 355-365.

B3. Rapp, R., P. Zweigenbaum, and S. Sharoff, *Proceedings of the 3rd Workshop on Building and Using Comparable Corpora* 2010: ELDA. 78p.

B4. SanJuan, E., P. Bellot, V. Moriceau, and X. Tannier, *Overview of the INEX 2010 question-answering track (QA@INEX)*, in *Lecture Notes in Computer Science, Comparative Evaluation of Focused Retrieval. 9th International Workshop of the Initiative for the Evaluation of XML Retrieval (INEX 2010), Revised and Selected Papers, volume 6932*, S. Geva, et al., Eds. 2011, Springer. pp. 269-281.

B5. Sansonnet, J.-P., A. Braffort, J.-C. Martin, and C. Verrecchia, *Towards interactive wab-based signing avatars*, in *Gesture in embodied communication and human-computer interaction, LCNS/LNAI 5934*, S. Kopp and I. Wachsmuth, Eds. 2010, Springer. pp. 313-324.

B6. Segouat, J. and A. Braffort, *Toward modeling sign language coarticulation*, in *Gesture in embodied communication and human-computer interaction, LCNS/LNAI 5934*, S. Kopp and I. Wachsmuth, Eds. 2010, Springer. pp. 325-336.

B7. Tannier, X., *Se protéger sur Internet. Conseils pour la vie en ligne* 2010: Eyrolles. 218p.

B8. Tannier, X. and V. Moriceau, *Studying syntactic analysis in a QA system: FIDJI@ResPubliQA'09*, in *Multilingual Information Access Evaluation I. Text Retrieval Experiments. (Proceedings of 10th Workshop of the Cross-Language Evaluation Forum, CLEF 2009, Corfu, Greece, September 30 - October 2, 2009, Revised Selected Papers, Part I)*, C.A.N.D.D.N.G.M. Peters, et al., Eds. 2010, Springer. pp. 237-244.

B9. Zweigenbaum, P., R. Rapp, and S. Sharoff, *Proceedings of the 4th Workshop on Building and Using Comparable Corpora: Comparable Corpora and the Web* 2011: Association for Computational Linguistics. 151p.

Conferences with proceedings and review committee

C1. Albert, P., F. Badin, M. Delorme, N. Devos, S. Papazoglou, and J. Simard. *Décennie d?un article de journal par analyse statistique et lexicale*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2010. Montréal, Canada. 13p.

C2. Arnulphy, B. *A weighted lexicon of French names*. in *RANLP2011, Student research workshop at Recent Advances in Natural Language Processing*. 2011. 8p.

C3. Arnulphy, B., X. Tannier, and A. Vilnat. *Les entités nommées événement et les verbes de cause-conséquence*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2010. Montréal, Canada. 6p.

C4. Arnulphy, B., X. Tannier, and A. Vilnat. *Un lexique pondéré des noms d'événements en français*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2011. Montpellier, France. 6p.

C5. Ben Abacha, A. and P. Zweigenbaum. *MeTAE : plate-forme d'annotation automatique et d'exploration sémantiques pour le domaine médical*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2010. Montréal, Canada. 4p.

C6. Ben Abacha, A. and P. Zweigenbaum. *Automatic extraction of semantic relations between medical entities: application to the treatment relation*. in *International Symposium on Semantic Mining in Biomedicine*. 2010. Hinxton, UK. 8p.

C7. Ben Abacha, A. and P. Zweigenbaum. *A hybrid approach for the extraction of semantic relations from MEDLINE abstracts*. in *International Conference on Intelligent Text Processing and Computational Linguistics*. 2011. Tokyo, Japan: Springer. 139-150.

C8. Ben Abacha, A. and P. Zweigenbaum. *Medical entity recognition: a comparison of semantic and statistical methods*. in *Workshop on Biomedical Natural Language Processing*. 2011. Portland, USA: Association for Computational Linguistics. 56-64.

C9. Bernhard, D. *Query expansion based on pseudo relevance feedback from definition clusters*. in *International Conference on Computational Linguistics*. 2010. Beijing, China. 54-62.

C10. Bernhard, D. and A.-L. Ligozat. *Analyse automatique de la modalité et du niveau de certitude : application au domaine médical*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2011. Montpellier, France. 12p.

C11. Bouamor, D., N. Semmar, and P. Zweigenbaum. *Improved statistical machine translation using multiword expressions*. in *International Workshop on Using Linguistic Information for Hybrid Machine Translation*. 2011. Barcelona, Spain: Universitat Politècnica de Catalunya. 15-20.

C12. Bouamor, H. *Construction d'un corpus de paraphrases d'énoncés par traduction multiple multilingue*. in *Rencontres des Etudiants Chercheurs en Informatique pour le Traitement Automatique des Langues*. 2010. Montréal, Canada. 10p.

C13. Bouamor, H., A. Max, G. Illouz, and A. Vilnat. *Web-based validation for contextual targeted paraphrasing*. in *ACL Workshop on Monolingual Text-To-Text Generation*. 2011: Association for Computational Linguistics. 10-19.

C14. Bouamor, H., A. Max, and A. Vilnat. *Acquisition de paraphrases sous-phrastiques depuis des paraphrases d'énoncés*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2010. Montréal, Canada. 6p.

C15. Bouamor, H., A. Max, and A. Vilnat. *Comparison of paraphrase acquisition techniques on sentential paraphrases*. in *International Conference on Natural Language Processing*. 2010. Reykjavik, Iceland. 12p.

C16. Bouamor, H., A. Max, and A. Vilnat. *Monolingual alignment by edit rate computation on sentential paraphrase pairs*. in *Annual Meeting of the Association for Computational Linguistics: Human Language Technologies*. 2011. Portland, USA. 395-400.

C17. Bouamor, H., A. Max, and A. Vilnat. *Combinaison d'informations pour l'alignement monolingue*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2011. Montpellier, France. 531-542.

C18. Braffort, A., L. Bolot, E. Chételat-Pelé, A. Choisier, G. Delorme, M. Filhol, J. Segouat, C. Verrecchia, F. Badin, and N. Devos. *Sign language corpora for analysis, processing and evaluation*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 4p.

C19. Braffort, A., L. Bolot, and J. Segouat. *Virtual signer coarticulation in Octopus, a Sign Language generation platform*. in *International Gesture Workshop*. 2011. Athens, Greece. 29-32.

C20. Braffort, A., M. Filhol, and J. Segouat. *Traitement automatique des langues des signes : le projet Dicta-Sign, des corpus aux applications*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2010. Montréal, Canada. 4p.

C21. Campion, N., J. Closson, O. Ferret, J. Shin, B. Grau, J. Lazard, D. Lahbib, R. Besancon, J. Floret, A. Mezaour, and X. Tannier. *FILTRAR-S : un outil de filtrage sémantique et de fouille de textes pour la veille*. in *Colloque international Veille Stratégique Scientifique & Technologique*. 2010. Toulouse, France. 16p.

C22. Cartoni, B. and M. Lefer. *The MuLeXFoR database: representing word-formation processes in a multingual lexicographic environment*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 6p.

C23. Cartoni, B. and M. Lefer. *Improving the representation of word-formation in multilingual lexicographic tools: the MuLeXFoR database*. in *EURALEX International Congress*. 2010. Leeuwarden, The Netherlands. 6p.

C24. Cartoni, B. and P. Zweigenbaum. *Semi-automated extension of a specialized medical lexicon for French*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 6p.

C25. Cartoni, B. and P. Zweigenbaum. *Extension of a specialised lexicon using specific terminological data: the unified medical lexicon for French (UMLF)*. in *EURALEX International Congress*. 2010. Leeuwarden, The Netherlands. 6p.

C26. Chételat-Pelé, E. and A. Braffort. *Investigation et analyse des GNM impliqués en LSF : le cas des clignements*. in *Traitement Automatique des Langues Naturelles - Atelier Traitement Automatique des Langues des Signes*. 2010. Montréal, Canada. 6p.

C27. Chételat-Pelé, E. and A. Braffort. *Investigation and analysis of non manual gestures involved in LSF: blinking*. in *International Gesture Workshop*. 2011. Athens, Greece. 76-79.

C28. Crego, J.-M., A. Max, and F. Yvon. *Local lexical adaptation in machine translation through triangulation: SMT helping SMT*. in *International Conference on Computational Linguistics*. 2010. Beijing, China. 232-240.

C29. Dameron, O., P. Van Hille, L. Temal, A. Rosier, L. Deléger, C. Grouin, and P. Zweigenbaum. *Comparison of OWL and SWRL-based ontology modeling strategies for the determination of pacemaker alerts severity*. in *AMIA Annual Symposium*. 2011. Washington, USA. 10p.

C30. De Groc, C. *Babouk : focused web crawling for corpus compilation and automatic terminology extraction*. in *IEEE/WIC/ACM International Conference on Web Intelligence*. 2011. Lyon, France. 497-498.

C31. De Groc, C., X. Tannier, and J. Couto. *GrawlTCQ: terminology and corpora building by ranking simultaneously terms, queries and documents using graph random walks*. in *TextGraphs-6. Graph-based Methods for Natural Language Processing. Workshop at ACL-HLT 2011*. 2011. Portland, USA. 37-41.

C32. De Viron, L., D. Bernhard, V. Moriceau, and X. Tannier. *Génération automatique de questions à partir de textes en français*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2011. Montpellier, France. 6p.

C33. Delbecque, T. and P. Zweigenbaum. *Using co-authoring and cross-referencing information for MEDLINE indexing*. in *AMIA Annual Symposium*. 2010. Washington, USA. 147-151.

C34. Deléger, L. and B. Cartoni. *Adjectifs relationnels et langue de spécialité: vérification d'une hypothèse linguistique en corpus medical comparable.* in *Conférence sur le Traitement Automatique des Langues Naturelles.* 2010. Montréal, Canada. 6p.

C35. Deléger, L., C. Grouin, and P. Zweigenbaum. *Extracting medication information from French clinical texts.* in *International Congress on Medical Informatics.* 2010. Cape Town, South Africa. 949-953.

C36. Deléger, L., T. Merabti, T. Lecrocq, M. Joubert, P. Zweigenbaum, and S. Darmoni. *A twofold strategy for translating a medical terminology into French.* in *AMIA Annual Symposium.* 2010. Washington, USA. 152-156.

C37. Deléger, L. and P. Zweigenbaum. *Identifying paraphrases between technical and lay corpora.* in *International Conference on Language Resources and Evaluation.* 2010. Valetta, Malta. 6p.

C38. Delorme, M., M. Filhol, and A. Braffort. *Thumb modeling for the generation of Sign Language.* in *International Gesture Workshop.* 2011. Athens, Greece. 37-40.

C39. Dutrey, C., H. Bouamor, D. Bernhard, and A. Max. *Paraphrases et modifications locales dans l'historique des révisions de Wikipédia.* in *Conférence sur le Traitement Automatique des Langues Naturelles.* 2011. Montpellier, France. 12p.

C40. Efthimiou, E., S. Fotinea, T. Hanke, J. Glauert, R. Bowden, A. Braffort, C. Collet, P. Maragos, and F. Goudenove. *DICTA-SIGN : sign language recognition, generation and modelling with appllications in deaf communication.* in *Workshop on the Representation and Processing of Sign Languages : Corpora and Sign Language Technologies in conjunction with LREC 2010.* 2010. Valetta, Malta. 80-83.

C41. El Ayari, S., B. Grau, and A.-L. Ligozat. *Fine-grained linguistic evaluation of question answering systems.* in *International Conference on Language Resources and Evaluation.* 2010. Valetta, Malta. 7p.

C42. Filhol, M. *Stabilisation d?un modèle à contraintes pour la représentation lexicale des langues des signes.* in *Traitement Automatique des Langues Naturelles - Atelier Traitement Automatique des Langues des Signes.* 2010. Montréal, Canada. 7p.

C43. Filhol, M. *Search through lexical sign bases with a constraint-based model.* in *Theoretical Issues on Sign Language Research Conference.* 2010. Purdue, USA. 4p.

C44. Filhol, M. *A combination of two synchronisation methods to formalise Sign Language animation.* in *International Gesture Workshop.* 2011. Athens, Greece. 1-4.

C45. Filhol, M. *Text--sign parallel corpus study to start designing an automatic translation system.* in *Second International Workshop on Sign Language Translation and Avatar Technology (SLTAT).* 2011: University of Dundee. 1-7.

C46. Filhol, M., M. Delorme, and A. Braffort. *Combining constraint-based models for sign language synthesis.* in *Workshop on the Representation and Processing of Sign Languages : Corpora and Sign Language Technologies in conjunction with LREC 2010.* 2010. Valetta, Malta. 88-91.

C47. Galibert, O., L. Quintard, S. Rosset, P. Zweigenbaum, C. Nedellec, S. Aubin, L. Gillard, J. Raysz, D. Pois, X. Tannier, L. Deléger, and D. Laurent. *Named and specific entity detection in varied data : the Quaero named entity baseline evaluation.* in *International Conference on Language Resources and Evaluation.* 2010. Valetta, Malta. 6p.

C48. Galibert, O., S. Rosset, C. Grouin, P. Zweigenbaum, and L. Quintard. *Structured and extended named entity evaluation in automatic speech transcriptions.* in *International Joint Conference on Natural Language Processing.* 2011. Chiang Mai, Thailand. 518-526.

C49. Galibert, O., S. Rosset, X. Tannier, and F. Grandry. *Hybrid citation extraction from patents.* in *International Conference on Language Resources and Evaluation.* 2010. Valetta, Malta. 5p.

C50. Garcia-Fernandez, A., A.-L. Ligozat, M. Dinarelli, and D. Bernhard. *When was it written? Automatically determining publication dates.* in *International Symposium on String Processing and Information Retrieval.* 2011. Pise, Italie. 12p.

C51. Garcia-Fernandez, A., S. Rosset, and A. Vilnat. *MACAQ : A multi annotated corpus to study how we adapt answers to various questions.* in *International Conference on Language Resources and Evaluation.* 2010. Valetta, Malta. 7p.

C52. Garcia-Fernandez, A., S. Rosset, and A. Vilnat. *Comment formule-t-on une réponse en langue naturelle?* in *Conférence sur le Traitement Automatique des Langues Naturelles.* 2010. Montréal, Canada. 10p.

C53. Garcia-Fernandez, A., I. Vasilescu, and S. Rosset. *Euh as cue for speaker confidence and word searching in human spoken answers in French.* in *Workshop on Disfluency in Spontaneous Speech - The 2nd International Symposium on Linguistic Patterns in Spontaneous Speech.* 2010. Tokyo, Japan. 2p.

C54. Grappy, A. and B. Grau. *Answer type validation in question answering systems.* in *International Conference on Adaptivity, Personalization and Fusion of Heterogeneous Information.* 2010. Paris, France. 7p.

C55. Grappy, A. and B. Grau. *Validation du type de la réponse dans un système de questions réponses.* in *Conférence en Recherche d'Information et Applications.* 2010. Sousse, Tunisie. 16p.

C56. Grappy, A., B. Grau, M.-H. Falco, A.-L. Ligozat, I. Robba, and A. Vilnat. *Selecting answers to questions from Web documents by a robust validation process.* in *IEEE/WIC/ACM International Conference on Web Intelligence.* 2011. Lyon, France. 8p.

C57. Grappy, A., B. Grau, M.-H. Falco, A.-L. Ligozat, I. Robba, and A. Vilnat. *Sélection de réponses à des questions dans un corpus Web par validation*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2011. Montpellier, France. 6p.

C58. Grappy, A., B. Grau, O. Ferret, C. Grouin, V. Moriceau, I. Robba, X. Tannier, and A. Vilnat. *A corpus for studying full answer justification*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 7p.

C59. Grouin, C., L. Deléger, B. Cartoni, S. Rosset, and P. Zweigenbaum. *Accès au contenu sémantique en langage de spécialité : extraction des prescriptions et concepts médicaux*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2011. Montpellier, France. 12p.

C60. Grouin, C., L. Deléger, A. Rosier, L. Temal, O. Dameron, P. Van Hille, A. Burgun, and P. Zweigenbaum. *Automatic computation of CHA2DS2-VASc score: information extraction from clinical texts for thromboembolism risk assessment*. in *AMIA Annual Symposium*. 2011. Washington, USA. 10p.

C61. Grouin, C., M. Dinarelli, S. Rosset, G. Wisniewski, and P. Zweigenbaum. *Coreference resolution in clinical reports. The LIMSI participation in the i2b2/VA 2011 Challenge*. in *i2b2/VA Challenge*. 2011: i2b2 / VA. 1-10.

C62. Grouin, C., S. Rosset, P. Zweigenbaum, K. Fort, O. Galibert, and L. Quintard. *Proposal for an extension of traditional named entities: from guidelines to evaluation, an overview*. in *Linguistic Annotation Workshop*. 2011. Portland; USA. 92-100.

C63. Ivanova, E., D. Bernhard, and C. Grouin. *Handling outlandish occurrences: using rules and lexicons for correcting NLP articles*. in *13th European Workshop on Natural Language Generation*. 2011: ENLG. 254-256.

C64. Matthes, S., T. Hanke, J. Storz, E. Efthimiou, N. Dimou, P. Karioris, A. Braffort, A. Choisier, J. Pelhate, and E. Safar. *Elicitation tasks and materials designed for DICTA SIGN's multi-lingual corpus*. in *Workshop on the Representation and Processing of Sign Languages : Corpora and Sign Language Technologies in conjunction with LREC 2010*. 2010. Valetta, Malta. 158-163.

C65. Max, A. *Example-based paraphrasing for improved phrase-based statistical machine Translation*. in *Conference on Empirical Methods in Natural Language Processing*. 2010. Cambridge, USA. 11p.

C66. Max, A., J.-M. Crego, and F. Yvon. *Contrastive lexical evaluation of machine translation*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 5p.

C67. Max, A. and G. Wisniewski. *Mining naturally-occurring corrections and paraphrases from Wikipedia's revision history*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 6p.

C68. Minard, A.-L., A.-L. Ligozat, and B. Grau. *Extraction de résultats expérimentaux d'articles scientifiques pour le peuplement d'une base de données*. in *International Conference Journées d'Analyse statistique des Données Textuelles*. 2010. Rome, Italie. 779-790.

C69. Minard, A.-L., A.-L. Ligozat, and B. Grau. *Extraction de relations dans des comptes rendus hospitaliers*. in *Journées Francophones d'Ingénierie des Connaissances*. 2011. Chambéry, France. 16p.

C70. Minard, A.-L., A.-L. Ligozat, and B. Grau. *Apport de la syntaxe pour l'extraction de relations en domaine médical*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2011. Montpellier, France. 11p.

C71. Minard, A.-L., A.-L. Ligozat, and B. Grau. *Multi-class SVM for relation extraction from clinical reports*. in *Recent Advances in Natural Language Processing*. 2011. Hissar, Bulgaria. 604-609.

C72. Minard, A.-L., L. Makour, A.-L. Ligozat, and B. Grau. *Feature selection for drug-drug interaction detection using machine-learning based approaches*. in *DDIExtraction 2011. First Challenge Task: Drug-Drug Interaction Extraction - SEPLN 2011 satellite workshop*. 2011. Huelva, Spain. 43-50.

C73. Moriceau, V., X. Tannier, and M.-H. Falco. *Une étude des questions "complexes" en question-réponse*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2010. Montréal, Canada. 6p.

C74. Pak, A., D. Bernhard, P. Paroubek, and C. Grouin. *A combined approach to emotion detection in suicide notes. The LIMSI participation in the i2b2/VA 2011 Challenge*. in *i2b2/VA Challenge*. 2011, 10p.

C75. Pak, A. and P. Paroubek. *Twitter as a corpus for sentiment analysis and opinion mining*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 6p.

C76. Pak, A. and P. Paroubek. *Construction d'un lexique affectif pour le français à partir de Twitter*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2010. Montréal, Canada. 6p.

C77. Pak, A. and P. Paroubek. *Text representation using dependency tree subgraphs for sentiment analysis*. in *International Conference on Database Systems for Advanced Applications*. 2011. Hong Kong, China. 323-332.

C78. Pak, A. and P. Paroubek. *Classification en polarité de sentiments avec une représentation textuelle à base de sous-graphes d'arbres de dépendances*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2011. Montpellier, France. 11p.

C79. Pak, A. and P. Paroubek. *Normalization of Term Weighting Scheme for Sentiment Analysis*. in *Language and Technology Conference*. 2011. Poznan', Poland. 415-419.

C80. Paroubek, P., A. Pak, and D. Mostefa. *Annotations for opinion mining evaluation in the industrial context of the DOXA project*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 6p.

C81. Quintard, L., O. Galibert, D. Laurent, S. Rosset, G. Adda, V. Moriceau, X. Tannier, B. Grau, and A. Vilnat. *Question answering on web data : the QA evaluation in Quaero*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 7p.

C82. Sadoun, D., C. Dubois, Y. Ghamri-Doudane, and B. Grau. *An ontology for the conceptualization of an intelligent environment and its operation*. in *Mexican International Conference on Artificial Intelligence*. 2011. Puebla, Mexico. 7p.

C83. Tannier, X. and V. Moriceau. *FIDJI : web question-answering at Quaero 2009*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 5p.

C84. Tannier, X. and V. Moriceau. *FIDJI @ ResPubliQA'10*. in *MLQA 2010. CLEF 2010 Workshop on Multiple Language Question Answering*. 2010.

C85. Vasilescu, I., S. Rosset, and M. Adda-Decker. *On the functions of the vocalic hesitation euh in interactive man-machine question answering dialogs in French*. in *Workshop on Disfluency in Spontaneous Speech - The 2nd International Symposium on Linguistic Patterns in Spontaneous Speech*. 2010. Tokyo, Japan. 4p.

C86. Vilnat, A., P. Paroubek, E. Villemonte De La Clergerie, G. Francopoulo, and M. Guénot. *Passage syntactic representation: a minimal common ground for evaluation*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 6p.

C87. Wang, W., R. Besancon, O. Ferret, and B. Grau. *Filtering and clustering relations for unsupervised information extraction in open domain*. in *ACM international Conference on Information and Knowledge Management (CIKM 2011)*. 2011. Glasgow, Scotland, UK. 1405-1414.

C88. Wang, W., R. Besancon, O. Ferret, and B. Grau. *Filtrage de relations pour l'extraction d'information non supervisée*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2011. Montpellier, France. 6p.

C89. Wisniewski, G., A. Max, and F. Yvon. *Recueil et analyse d'un corpus écologique de corrections orthographiques extrait des révisions de Wikipédia*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2010. Montréal, Canada. 10p.

C90. Zhu, Z., D. Bernhard, and I. Gurevych. *A monolingual tree-based translation model for sentence simplification*. in *International Conference on Computational Linguistics*. 2010. Beijing, China. 1353-1361.

Conferences without proceedings, workshops

D1. Arnulphy, B., X. Tannier, and A. Vilnat. *Vers une extraction automatique des événements dans les textes*. in *Colloque international Langage, Discours, Evénements*. 2011. Florence, Italie.

D2. Braffort, A. *Annotation for sign language processing*. in *Sign Linguistics Corpora Network, 3rd Workshop on Annotation*. 2010.

D3. Braffort, A. and M. Filhol. *Text to SL translation*. in *First International Workshop on Sign Language Translation and Avatar Technology (SLTAT)*. 2011: ACM. 1-2.

D4. Campion, N., J. Closson, O. Ferret, R. Besancon, W. Wang, J. Shin, J. Floret, B. Grau, X. Tannier, A. Mezaour, and J. Lazard. *FILTRAR-S : nouveaux développements*. in *WISG 2011. Cinquième Workshop Interdisciplinaire sur la Sécurité Globale*. 2011. 14p.

D5. Chowdhury, F., A. Ben Abacha, A. Lavelli, and P. Zweigenbaum. *Two different machine learning techniques for drug-drug interaction extraction*. in *DDIExtraction 2011. First Challenge Task: Drug-Drug Interaction Extraction*. 2011: Universidad Carlos III de Madrid. 19-26.

D6. De Groc, C., J. Couto, H. Blancafort, and C. De Loupy. *Babouk - exploration orientée du web pour la constitution de corpus et de terminologies*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2011. Montpellier, France.

D7. Delorme, M., A. Braffort, and M. Filhol. *Automatic generation of French Sign Language*. in *First International Workshop on Sign Language Translation and Avatar Technology (SLTAT)*. 2011: ACM. 1-2.

D8. Garcia-Fernandez, A., A.-L. Ligozat, and D. Bernhard. *Présent, hypothétique, conditionnel ? Annotation du statut des problèmes médicaux dans des comptes rendus cliniques en français*. in *1st Symposium sur l'Ingénierie de l'Information Médicale (SIIM 2011)*. 2011: IRIT/CNRS.

D9. Garcia-Fernandez, A., A.-L. Ligozat, M. Dinarelli, and D. Bernhard. *Méthodes pour l'archéologie linguistique : datation par combinaison d'indices temporels*. in *Atelier Défi Fouille de Textes*. 2011: TALN. 12p.

D10. Garcia-Flores, J., M. Deckert, W. Turner, and M. Hurault-Plantet. *The semantics of involvement: mining the web to locate biomedical expertise*. in *International Symposium on Semantic Mining in Biomedicine*. 2010. Hinxton, UK.

D11. Grouin, C., A. Ben Abacha, D. Bernhard, B. Cartoni, L. Deléger, B. Grau, A.-L. Ligozat, A.-L. Minard, S. Rosset, and P. Zweigenbaum. *CARAMBA: Concept, Assertion, and Relation Annotation using machine-learning-based approaches.* in *Fourth i2b2/VA Shared-Task and Workshop Challenges in Natural Language Processing for Clinical Data.* 2010: i2b2/VA. 1.

D12. Grouin, C., D. Forest, L. Da Sylva, P. Paroubek, and P. Zweigenbaum. *Présentation et résultats du défi fouille de texte DEFT2010 : où et quand un article de presse a-t-il été écrit ?* in *Atelier Défi Fouille de Textes.* 2010: TALN. 15p.

D13. Grouin, C., D. Forest, P. Paroubek, and P. Zweigenbaum. *Présentation et résultats du défi fouille de texte DEFT2011. Quand un article de presse a-t-il été écrit ? À quel article scientifique correspond ce résumé ?* in *Atelier Défi Fouille de Textes.* 2011: TALN.

D14. Grouin, C., O. Galibert, S. Rosset, L. Quintard, and P. Zweigenbaum. *Mesures d'évaluation pour entités nommées structurées.* in *Ateliers joints QDC'2011 - EvalECD'2011. Évaluation des méthodes d'Extraction de Connaissances dans les Données.* 2011. 13p.

D15. SanJuan, E., P. Bellot, V. Moriceau, and X. Tannier. *Overview of the 2010 QA Track: Preliminary results.* in *Initiative for the Evaluation of XML Retrieval Workshop (INEX 2010).* 2010. 5p.

D16. SanJuan, E., V. Moriceau, X. Tannier, P. Bellot, and J. Mothe. *Overview of the INEX 2011 Question Answering Track (QA@INEX).* in *Initiative for the Evaluation of XML Retrieval Workshop (INEX 2011).* 2011. 145-153.

D17. Zweigenbaum, P. *Building and acquiring resources for biomedical language processing.* in *2nd Workshop on Building and Evaluating Resources for Biomedical Text Mining (BioTxTM 2010).* 2010: ELRA.

Jean-Luc Gauvain

Introduction

The Spoken Language Processing group carries out research aimed at understanding the human speech communication processes and developing models for use in automatic processing of speech. This research is by nature interdisciplinary, drawing upon expertise in signal processing, acoustic-phonetics, phonology, semantics, statistics and computer science. The group's research activities are validated by developing systems for automatic processing of spoken language such as speech recognition, language identification, multimodal characterization of speakers and their affective state, named-entity extraction and question-answering, spoken dialog, multimodal indexation of audio and video documents, and machine translation of both spoken and written language.

With the aim of extracting and structuring information in audio documents, the group develops models and algorithms that use diverse sources of information to carry out a global decoding of the signal, that can be applied to identify the speaker, the language being spoken if it is not known a priori, the affect, to transcribe the speech or translate it, or identify specific entities.

The research of the group is structured in seven interdependent topics: Speaker characterization in a multimodal context (Topic 1); Affective and social dimensions of spoken interactions (Topic 2); Perception and automatic processing of variation in speech (Topic 3); Robust analysis of spoken language and dialog systems (Topic 4); Translation and machine learning (Topic 5); Speech recognition (Topic 6); Language resources (Topic 7). This last topic provides infrastructure for the other research topics.

Speaker recognition consists of determining who spoke when, where the identity can be that of the true speaker or an identity specific to one document or a set of documents. Different sources of information can be used to identify the speaker in multimedia documents (the speaker's voice, what is said, or what is written (Topic 1). The group is leading the QCOMPERE consortium for the REPERE challenge.

Affective and social dimension detection are being applied to both human-machine interaction with robots and in the analysis of audiovisual documents such as call center data. The main research subjects in Topic 2 are Speaker and emotion identification in human-robot interaction, Emotion detection in Client/Agent interaction, Emotion detection based on acoustic, visual and physiological cues for Assistive Robotics, and Multimodal detection of the anxiety applied to therapeutic serious games.

The very large corpora used for training statistical models are also exploited for linguistic studies of spoken language, such as acoustic-phonetics, pronunciation variation and diacronic evolution. Automatic alignment enables studies on hundreds to thousands of hours of data, permitting the validation of hypotheses and models (Topic 3). This topic also studies human and machine transcription errors via perception experiments.

Robust analysis methods for the spoken language (Topic 4) are developed in the framework of open domain information retrieval with applications to language understanding for dialog systems, to named-entity recognition, and to interactive question answering systems supporting both spoken and written languages.

Statistical machine translation (Topic 5) is an intensive area of research for the group today with the development of novel language and translation models as well as novel decoding strategies. This research area is closely related to the development of machine learning tools with two major achievements: the Wapita open source software for linear chain CRFs, and the development of new tools for neural network language model training.

Speech recognition (Topic 6) is the process of transcribing the speech signal into text. Depending upon the targeted use, the transcription can be completed with punctuation, with paralinguistic information such as hesitations, laughter or breath noises. Research on speech recognition relies on supporting research in acoustic-phonetic modeling, lexical modeling and language modeling (a problem also addressed for machine translation), which are undertaken in a multilingual context (18 languages).

In addition to the collection, annotation and sharing of varied corpora, Topic 7 addresses more general investigations on Language Resources, covering data, tools, evaluation and meta-resources (guidelines, methodologies, metadata, best Practice), for spoken and written language. Those activities are mostly

conducted in collaboration with national and international organizations and networks.

The group has a long history of evaluating our research in the context of international and national evaluation campaigns. In 2010 and 2011 we have participated in NIST organized benchmarks on speaker and language recognition (SRE'10, LRE'11), speech recognition (DARPA GALE 2010, 2011; Evalita 2011), Machine Translation (WMT'10,'11 and IWSLT'10,'11), as well as the yearly evaluations organized under the Quaero program for ASR, MT, named-entities, Q&A systems, and speaker diarization.

We also supported the MediaEval 2010, 2011 and TrecVid 2007-2011 evaluations by providing automatic transcripts for several hundreds of hours of audio data.

Thanks to the Quaero program and numerous other research projects, the means of the group, both in terms of human personnel and computer equipment, have grown significantly over the last few years. As of December 2011, the group has 43 members -- 12 permanent CNRS, 6 faculty members, 11 postdocs, 2 contractual research staff, and 12 doctoral students. More than 35 additional contractual staff were hired to annotate data in support of Quaero activities. The Digiteo program has also strongly supported the group, partially financing renewal of the computing infrastructure needed for the training and evaluation of large statistical models, as well as a 3 month scientific visit for Dimitra Vergyri (SRI) and a 3 year half-time chair for Hermann Ney (RWTH).

In addition to its research activities, the group is responsible for several graduate level speech processing courses, principally at the University of Paris-Sud. In 2010 and 2011 the members of the group published 147 articles (21 in journals, 28 chapters in books, and 97 reviewed conference papers).

Research presentation

Topic 1: Speaker characterization in a multimodal context

C. Barras, *H. Bredin, C.T. Do, J-L. Gauvain, L. Lamel, V-B. Le, J-L. Rouas, Viet-A. Tran*

Timbre, prosody, accent or idiomatic expressions can all provide cues for speaker characterization, however most state-of-the-art automatic systems for speaker recognition rely on a modeling of a short-term spectral analysis of the speech signal, focusing mainly on the timbre information. Gaussian Mixture Models (GMM) of a generic model of speech are often a building block of such a system, even if they are combined with other modelings such as Support Vector Machines (SVM) or more recently the i-vector representation. We participated since 2002 to the international evaluations on speaker verification organized by the NIST (National Institute of Standard and Technologies, USA) and performed studies on features and score normalisation, unsupervised adaptation, prosodic features and speaker adaptation methods as features, especially MLLR (Maximum Likelihood Linear Regression) adaptation.

Speaker recognition can have applications for security, access control and forensic, but also for audiovisual documents analysis and multimodal applications. Speaker diarization, defined as an automatic acoustic segmentation and clustering into speaker turns, can enrich an automatic transcription and improve its readability and more generally the search into audiovisual archives. Our approach for speaker diarization consists in a multi-stage architecture, combining a first BIC-based (Bayesian Information Criterion) agglomerative clustering stage optimized for providing pure clusters and second stage with the CLR (Cross Log-likelihood Ratio) criterion as cluster distance, taking advantage of an increased amount of data per cluster with more complex models. Integration of speaker recognition approaches into a diarization system proved to be fruitful, bringing state-of-the-art performance in several national and international evaluations.

In the framework of the Quaero program, we aim to improve speaker diarization for multimedia broadcast data. We combined speaker diarization with speaker identification of known speakers for broadcast news and conversations, either with GMM speaker models adapted from a generic model or with a SVM classifier for speaker segmentation and tracking. We also considered the situation where a collection of shows from the same source has to be processed. This is frequent for digital library and multimedia archives and it is likely that in this case some speakers (journalists, actors, frequent guests …) will occur in several shows. It is important that a given speaker shares the same identifier across all the shows. With our partners of the Quaero program, we have addressed this cross-show diarization task and have experienced different architectures for cross-show diarization, either with a global clustering or with an incremental presentation of the shows.

There are cases where voice is not the only cue available to identify a speaker. In TV broadcast news or talk shows for instance, guests or reporters identity is often provided as an overlaid text that can be automatically extracted using video optical character recognition (OCR). Similarly, it is common practice

for anchors to introduce their guests by quoting their name. In the framework of the QCOMPERE consortium for the REPERE challenge, we were able to greatly improve the performance of our supervised speaker identification system by combining those multimodal cues. Most importantly, this lays the ground for an unsupervised speaker identification system that can be useful when no or very little data is available to train speaker models. We proposed a completely unsupervised multimodal speaker identification system using video OCR to name the clusters provided by our state-of-art speaker diarization system. Results show that one can expect this unsupervised multimodal approach to get very close performance to the one of a supervised acoustic-only speaker identification system.

Speaker diarization also proved to be very helpful for several multimedia applications and audiovisual content structuring in particular. Through collaboration with the Institut de Recherche en Informatique de Toulouse, we rely on speaker diarization for most building blocks of a novel approach to automatic summarization of TV shows. First, a graph-based system for temporal segmentation into scenes relies on the multimodal fusion of color information, speaker diarization and automatic speech transcription. As modern TV shows usually contain multiple intricated stories, a subsequent semantic plot de-interlacing step relies on speaker diarization and other cues to group semantically similar scenes into coherent stories. The last ongoing step aims at summarizing each detected story into a short self-contained video excerpt for easier browsing.

Topic 2: Affective and social dimensions of spoken interactions

L. Devillers, C. Chastagnol, A. Delaborde, J. Mariani, M. Soury, M. Tahon, C. Vaudable

In order to design affective interactive systems, experimental grounding is required to study expressions of emotion and social clues during interaction. Socio-cultural clues are contrary to emotions voluntarily controlled. In human interaction, nonverbal elements such as gesture, facial expression and paralinguistic clues are valuable for a more precise understanding of the communicated message. Voice and speech play a fundamental role in social interactions, but they have been relatively neglected, at least in the last years, with respect to other aspects of social exchanges such as, e.g., facial expressions or gestures. There is a tendency within the area of emotion-oriented computing to take the easy option of emotion as it is portrayed by actors. It seems increasingly clear that the strategy leads nowhere, because the forms of expression that occur in natural interactions are fundamentally different from those that actors generate. Since 2001, the work on speech introduced in this theme is based on the use of genuinely naturalistic material. The team was one of the first to grasp the issue, and is one of a very small number of researchers who has consistently taken on the challenge of finding, annotating and analysing databases of "real-life" emotion. The team has collected and analysed speech databases of emotion in financial consultations, calls for medical help and human-robot interactions. Studies were led on various levels of fear (stress, anxiety, fear panics), of anger (annoyance, anger), of sadness (disappointment, sadness, depression) and of positive feelings (relief, satisfaction, enjoyment, pride). Through that, analysis techniques that extracted spectral, prosodic and affect burst markers and automatic emotion detection system using modelings such as Support Vector Machines (SVM) have been developed with recent comparisons which show that they are on a par with those developed at any other centers in the international community. A social robot sensitive to emotions should not take only punctual emotions into account, but also have a representation of the emotional and interactional profile of the user along the interactions, in order to have a chance of being more relevant in its behavioural responses. Our first step has been to study the way paralinguistic cues impact the human-robot interaction, by interpreting the low-level clues computed from speech into an emotional and interactional profile of the user. Being able to predict which specific behaviour will have a chance to trigger pleasure in the user is a plus. For example, someone dominant and with a high self-confidence will not need to be encouraged to interact, and this encouragement could even be seen as irrelevant, not to say boring. The system would provide a closed interaction loop, where the robot would react to the emotional message of the human, and triggers an emotional response in the human according to relevant chosen behaviours. There are many cases where voice is not the only clue available to identify emotion and social dimensions. We propose in our next steps of research to extract multimodal dimensions using eyes gaze tracking (with webcam), posture detection (with kinect) and some few physiological clues (EEG) with non-invasive sensor in order to improve the performance of our systems.

Affective and social dimension detection can be used for human-machine interaction with robots but also for audiovisual documents analysis with goals of health, security, education, entertainment or serious games applications. For example, in the framework of the Cap Digital FUI VoxFactory, we aim to analyze the quality of Client/Agent interaction in call center data (2009-11). Robotics are a relevant framework for assistive applications due to the learning and skills of robots. In the framework of the ANR Tecsan ARMEN, we

build an Assistive Robotics to Maintain Elderly people in Natural environment (2010-13). We participate to the Cap Digital FUI ROMEO project with two goals: build a social humanoid robot (a big brother of NAO developed by Aldebaran robotics) to help the visually impaired and elderly in their everyday activities and a game companion for children (2009-12). We also are involved in the Social committee of ROMEO, which aims at providing a societal vision on the design of the robot. Then, the FEDER E-THERAPY project is devoted to the design of immersive serious games with therapeutic vocation, based on the verbal and non-verbal interaction and the techniques of role plays (2012-2015). In the framework of the ANR Emco COMPARSE, we also study the relationships between cognition, motivation, and personality, for emotional adaptation and regulation, using empathic virtual simulation (2012-15). Research subjects developed in the team are : "Speaker and emotion identification in human-robot interaction", "Emotion detection for analyzing the quality of Client/Agent interaction in call center data", "Engagement in Human-Robot interaction", "Emotion detection based on acoustic, visual and physiological cues for Assistive Robotics" and finally "Multimodal detection of the anxiety for the design of a serious game with therapeutic purpose".

In a near future, socially assistive robotics aims to address critical areas and gaps in care by automating supervision, coaching, motivation, and companionship aspects of one-to-one interactions with individuals from various large and growing populations, including the elderly, children, disabled people and individuals with social phobias among many others. The ethical issues, including safety, privacy and dependability of robot behaviour, are also more and more widely discussed. It is thus necessary that a bigger ethical thought is combined with the scientific and technological development of robots, to ensure the harmony and acceptability of their relation with the human beings.

Topic 3: Perception and automatic processing of variation in speech

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In speech communication, considerable variability comes into play, raising issues for both humans and machines. The aim is to increase our knowledge in this area and to improve the performance of automatic speech processing systems. As a research topic, variation in speech (socially constructed, correlating to speaker groups or situations) can also benefit from technological advances, since its study requires large-scale phonetic analyses.

In addition to diachronic change, the sociolinguistic literature differentiates three types of variation in speech: diatopic (regional), diastratic (social) and diaphasic ("stylistic", within-speaker). This complex reality is routinely referred to in layman's terms as accents and speaking styles. Our work which focuses on these two issues combines perceptual and acoustic approaches to account for variation due to speakers' geographic and linguistic backgrounds (accents) as well as the communicative situation (styles). It is based on large amounts of data, using measurement tools derived from automatic speech processing techniques to quantify certain trends in the French language, especially. The evolution of non-standard variants in French broadcast news data is studied in collaboration with Maria Candea (Univ. Paris 3, sabbatical leave).

A first research axis is concerned with modelling identification and characterisation processes of regional and foreign accents in French. Perceptual experiments and acoustic analyses were carried out using automatic phoneme alignment, which could include pronunciation variants corresponding to Southern, Belgian, West-African, Maghrebi, English, German, Spanish and Portuguese accents, among others. In total, over 100 hours of regional- or foreign-accented French were analysed. Some of the most discriminating pronunciation features, such as the realisation of nasal vowels in Southern French or the realisation of certain schwas (backed and closed) in Portuguese-accented French were ranked using automatic learning techniques. Word-initial stress followed by a falling pitch contour was also evidenced in Senegalese-accented French and interpreted as a possible prosodic transfer from Wolof (the dominant language in Senegal) to French.

Since speech conveys both phonemic and prosodic information, the contribution of prosody to the perception of regional or foreign accents (Belgian, Italian, Polish, among others), the so-called *banlieue* accent and broadcasters' style was examined. The latter was studied from a diachronic perspective through newscast archives dating back to the nineteen forties. The methodology included various prosody transplantation and modification/ resynthesis. The contribution of prosody was highlighted especially for Belgian French, with peculiar vowel lengthening phenomena, Polish-accented French, with more word segmentation, the *banlieue* accent, with word-final sharp pitch falls, and the news announcer style of the forties and fifties, with a more marked tendency to initial stress than in the following decades.

Another research axis is concerned with acoustic-prosodic investigations of frequent homophone (or

near-homophone) word pairs in French, more recently extended to address and describe spontaneous speech in general, as found in conversations or interviews. Prosodic specificities have been studied based on a 30 hour dialogue corpus and compared to a 100-hour broadcast corpus of prepared (at least partially read) speech. Compared to broadcast news, spontaneous speech exhibits flatter melodic contours and less marked word segmentation: prosodic cues to word boundaries are less marked in spontaneous face-to-face speech, where speakers and interlocutors may interrupt their conversation at any point to clarify the subject, if ever some unsolvable ambiguity arose. Speaking style may cause differences in F0 profiles between determiners and nouns especially, in which F0 values are lower for spontaneous speech than for prepared speech. However, for both speaking styles, it can be asserted that in noun phrases F0 values start at a relatively low level and rise as soon as the first syllable of the following noun is produced.

Spontaneous speech is also characterised by the presence of a number of disfluencies (hesitations, repetitions, false starts) and discourse markers. These phenomena were studied in view of better understanding human strategies in verbal interaction management. The properties of some classical discourse markers (*bon, ben, alors, donc, enfin/m'enfin* etc.) and of the French hesitation *euh* in interactive speech man-machine and man-man question answering dialogs have been then investigated. The research was based on the working hypothesis that an automatic extraction of really informative words out of utterances may benefit from a smart handling of spontaneous speech-specific items such as vocalic hesitations and discourse markers. Preliminary results point out that these devices help start speaker turns and initiate rephrasing at two utterance levels: global (utterance-rewording) and local (utterance-internal). Utterance-internal rephrasing may concern a word, a phrase or a whole sentence within the on-going utterance. Also, classical discourse markers and the hesitation *euh* allow relevant information framing, in particular when occurring in utterance-internal position. On the long view, the modelling of such items may improve natural language generation and understanding.

Modelling the production and perception of variation in speech is of major importance for understanding possible sources of errors of automatic speech recognition systems. This holds particularly for reduced speech phenomena, as thoroughly investigated in a new corpus of casual French partly designed at LIMSI. The long-term aim of this research axis is to improve the modelling of ambiguous items so as to reduce automatic transcription errors. It is well-known that human listeners significantly outperform machines when transcribing speech. Perceptual paradigms have been developed in which human listeners are asked to transcribe broadcast speech segments containing words which are frequently misrecognised by the system. In particular, we sought to gain information about the impact of increased context to help humans disambiguate problematic lexical items, typically homophone or near-homophone words. The same methodology can be applied to other linguistic features, other languages, accents and styles. In future work, social factors should be better taken into account and interactions with other research groups are needed to link accents, speaking styles and expressive speech.

Topic 4: Robust analysis of spoken language and dialog systems

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The main motivations of our work in this research topic relate to the analysis of language (including oral) for interactive information retrieval in open domain. This implies a need for robustness given any kind of input (prepared speech, spontaneous speech, written texts, web documents, etc.) and for fast-processing techniques. Spoken document can be manually transcribed and then without errors or automatically transcribed (with errors). Moreover spontaneous speech can also include some typical phenomenas such as repairs, false starts, hesitations etc. Searching for information in speech data provides new challenges as compared to the more usual newspapers type documents often used in Question-Answering experiments. Speech syntax is different, and in particular far less rigid, than written language syntax. Structure tends to be more local, with individual chunks often following traditional grammar rules, and relations designed between them at a sometimes syntactic, but more often semantic, level. Analysis tools expecting long-range somewhat rigid structuration, for instance syntactic analyzers created for written, well-formed text, tend to fail when encountering speech. Analyzing speech requires the same kind of approach needed for the analysis of not-so-well formed, or simply unusual, text: *robustness*. A *robust analyzer* will not try for a complete analysis of a given sentence or document. It will work on a *best effort* basis, trying to produce as much structured information as possible, as reliably as possible, without expecting completeness. For Speech transcriptions, some parts can be interpreted within formalism, whichever its level (POS, syntax, Named Entities, Dialog Acts…), and some parts can't. Automatic speech recognition only exacerbates the need for robustness: not only errors are introduced in the transcription, but useful clues present in text are lost.

The lack of punctuation, for instance, reflects the loss of the *sentence* concept. Sentences relative self-containedness provides a useful boundary for analysis modules, limiting contexts sizes for rule-based systems or search space for stochastic ones. Commas provide chunks separations where ambiguity sometimes happens. For instance, in the sentence *by trial two thousand five hundred twenty tests has failed* did 20 tests fail or was that 520? Speech prosody would give the answer, a human transcriptor would write it down with a comma, but such an action is still outside automatic speech recognition systems capabilities. Speech contains intrisic ambiguities (at a word segmentation or a word identification level) the actual speech recognitions systems cannot solve; thus dealing with recognition errors (from 10 to 50% depending of the language and of the task) is a part of the QA task on spoken data. Speech has its advantages though: a speech recognition system produces an output in which words are clearly delimited, abbreviations are not used with their inherent ambiguity, uppercase, when present, is limited to proper nouns and acronyms. That pretty much eliminates all the tokenisation issues present with text. Ideally, a text at the entry of an analysis step would combine the advantages of both speech and written text: words separated from the punctuation and from each other, uppercase only on proper nouns and acronyms, punctuation present allowing for sentence splitting, etc. We thus defined a *normalized* form and the first step of any of our systems, no matter whether they work on speech or text, is a normalization step turning the input into that form. This work is based on the experience developed on normalizing data for language model building for ASR systems.

But once such a normalisation step is done, analyzing the input still has to be done. The robustness point of view defines analyzing as extracting as much structured information as possible from the data. Two complementary methodologies are at the center of our work. What is chosen depends on the use case.

The first case is driven by applications requiring extracting a set of fuzzily defined information out of speech. A typical case is spoken language understanding as used in open domain dialog systems. The capability for experimentation on the information classification itself is paramount. In such a case we privilege symbolic approaches. A efficient rules application engine designed for generalized incremental analysis was implemented and used to develop a wide domain, mostly semantic multi-level analysis for the French, English and Spanish languages.

The second case appends when the task is well defined and corpora are available. A typical case is the Named Entity recognition and classification task. For such problems, stochastic approaches are preferred. We proposed original approaches which are based on the previously presented structuring multi-level analysis providing features at the word level for known approaches such as Conditional Random Fields (CRF) when working on single-layer named entities (Ester project). We complement that approach with Probabilistic Context Free Grammars (PCFG) when handling semantically driven tree-structured named entities (Quaero project).

These systems are used in our Question-Answering (Quaero project) and spoken dialog systems (Ritel project) and brought on collaborations with other laboratories.

Our work on spoken language dialog systems is mainly concerned by interactive search in open domain and intelligent assistants. Our main scientific topic is the dialog management and more specifically his context and history management aspects. Our proposed model is based on the use of semantically motivated clusters and a three-step algorithm which manages explicit and implicit user and system confirmations. Our Ritel system is used as an experimental platform to validate our approaches.

Topic 5: Translation and machine learning

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Research activities in this theme are focused on testing, adapting and specializing *proven* and *sound* statistical Machine Learning algorithms to the peculiarities of Natural Language and Speech Processing data and problems. The main testbed is a final application, Machine Translation, which implies many intermediate sub-tasks (part-of-speech (POS) tagging, chunking, named-entity recognition (NER), etc) that can also be approached with ML tools. Besides their intrinsic complexity, these problems imply to deal with (i) very large and (ii) heterogeneous datasets, containing both (iii) annotated and non-annotated data; further, linguistic data is often (iv) structured and can be described by (v) myriads of linguistic features, involving (vi) complex statistical dependencies. These are the six main scientific challenges that are being addressed. However, contrarily to many teams working in this lively domain, improving the current state-of-the-art in Machine Translation, as measured in international evaluation campaigns, is also a major objective; thus the need

to develop and maintain internally an efficient MT engine.

Statistical Machine Translation (SMT)

Statistical Machine Translation systems rely on the statistical analysis of large bilingual corpora to train stochastic models describing the mapping between a source and a target language. In their simplest form, these models express probabilistic relationships between source and target strings of words, as initially formulated in the famous IBM models in the early nineties. More recently, these models have been extended to capture more complex representations (eg. chunks, trees, or dependency structures) and probabilistic mappings between these representations. Such models are typically trained from parallel corpora containing examples of source texts aligned with their translation(s), where the alignment is typically defined at the sub-sentential level.

In this context, LIMSI is developing its research activities in several directions, from the design of word and phrase alignment models, to the conception of novel translation or language models; from the exploration of new training or tuning methodologies to the development of new decoding strategies. All these innovations need to be evaluated and diagnosed, and significant efforts are devoted to the vexing issue of quality measurements of MT outputs. All these activities have been published in a number of international conferences or journal (see the Publications section). LIMSI is finally involved in a number of national and international projects (see the Project section).

Regarding alignment models, most recent work deals with the design and training of discriminative alignment techniques (Allauzen & Wisniewski, 2009; Tomeh et al, 2010, 2011a, 2011b) in order to improve both word alignment and phrases extraction. (Lardilleux et al, 2011a, 2011b) explores alternative alignment techniques, based on statistical association measures between *phrases*.

LIMSI's decoder, N-code, belongs to the class of n-gram based systems. In a nutshell, these systems define the translation as a two step process, in which an input source sentence is first non-deterministically reordered yielding a input word lattice containing several possible reorderings. This lattice is then translated monotonically using a bilingual n-gram model; as in the more standard approach, hypotheses are scored using several probabilistic models, the weights of which are tuned with minimum error weight training. Recent evolutions of this approach are described in (Crego & Yvon, 2009, 2010a, 2010b). This system is now released as an open source software (Crego & Yvon, 2011); an online demo is also available. As an alternative training strategy, a CRF-based translation model (Lavergne et al, 2011) has recently been proposed, which builds on an in-house CRF software (Lavergne et al, 2010).

LIMSI's activities are not restricted to these core modules of SMT systems and many other aspects of SMT are also investigated, such as "tuning" (Sokolov & Yvon, 2011), multi-source machine translation (Crego et al 2010a, 2010b), evaluation of MT (Max et al 2010, Wisniewski et al, 2010), extraction of parallel sentences from comparable corpora (Braham-Ghabiche et al, 2011), etc.

LIMSI's MT systems have taken part in several international MT evaluation campaigns. This includes a yearly participation to the WMT evaluation series (2006-2011), where LIMSI has consistently been ranked amongst the top systems, especially when translating into French. We have also partaken in the 2009 NIST MT evaluation for the Arabic-English task, as well as in the 2010 and 2011 IWSLT evaluations.

Machine Learning

LIMSI's activities in the area of Machine Learning bridge a gap between Machine Translation and Machine Learning: on the one hand, MT is a difficult application which provides us with a realistic testbed for many ML innovations. Conversely, it appears that the development of efficient, large-scale MT systems poses problems whose solutions can also be used in other contexts or give rise to generic solutions.

A major achievement is the development of Wapiti, an open source package for linear chain Conditional Random Fields (CRFs) tailored for very large scale tasks (Lavergne et al, 2010). Owing to a very careful implementation of the core routines (gradient computation and optimization procedure) and to the selection of very sparse models through l1 regularization, allied with a very expressive language for representing feature patterns, this package is able to handle very large feature sets (up to billion of features), very large label set (up to hundreds of features), and very large datasets (up to millions of instances). This software has achieved state-of-the-art performance for many NLP tasks (grapheme-to-phoneme conversion, POS, NER, etc) in a variety of languages.

Another recent achievement is the development of original architectures for training and using very large neural networks having millions of neurons on their output layer. These are especially useful in the context of Neural Network Language Models (NNLMs), a theme on which LIMSI has been contributing since (Schwenk

& Gauvain, 2002) and which has provided us consistent performance improvements in many tasks. The recent work of (Le & al, 2010, 2011) has lead the development of the first NNLMs capable of predicting very large output vocabularies and of taking advantage of large context (up to 10-grams). These models have been successfully used to rescore n-best lists for speech recognition and for machine translation. This work is currently being generalized to Neural Network Translation Models (Lavergne et al, 2011) which are even more demanding in terms of their output vocabulary (bilingual segments).

Topic 6: Speech recognition

L. Lamel, G. Adda, M-F. Ben Zeghiba, M. Adda-Decker, C.-T. Do, T. Fraga Da Silva, G. Garau, J-L. Gauvain, P. Karanasou, J. Kolar, V-B. Le, S. Meng, A. Messaoudi, I. Oparin, A. Roy, N. Snoeren, Q. Zhang

Speech recognition is concerned with converting the speech waveform, an acoustic signal, into a sequence of words. Today's most performant approaches are based on a statistical modelization of the speech signal. Our research addresses the most of the main components of state-of-the-art speech recognizers, that is, language modeling (in close collaboration with Topic 5), lexical representation, acoustic-phonetic modeling and decoding. The realization of any individual word is highly dependent on the individual speaker, the social context and the acoustic environment (cf Topic 2). Automatic speech recognizers, also called speech-to-text systems, must be able to handle such time-varying contextual effects. In addition to the changes in acoustic context, the system must be able to evolve over time to handle changes in style and topic, and to dynamically update the vocabulary. Language model adaptation aims to compensate for such changes in style, topic and dialect. For almost two decades, large vocabulary, continuous speech recognition has served as a focus for evaluation of models and algorithms. Over time the tasks have become more challenging and the number of languages and tasks addressed has grown.

One of the recent trends in speech-to-text systems is using discriminative techniques with large corpora to build more accurate models. The discriminative property can be included in the feature extraction by using discriminative classifiers such as multi-layer perceptrons (MLPs). By covering a wide temporal context MLP features can potentially capture different speech properties than the widely used short-term cepstral features. In addition, MLPs can be trained to deliver estimates of class posteriors which can be used as features for Gaussian mixture acoustic models. Training an MLP on large corpora requires efficient algorithms to remain computationally manageable. One of the important properties of MLP features is their complementarities to cepstral features. Research has addressed how to best include both feature types in a transcription system. Without adaption, the MLP features have better performance than standard cepstral features. However, once speaker adaptive training and unsupervised adaptation are used, the two feature types have comparable performances. Feature concatenation is an efficient combination method, providing the best gain at the lowest decoding cost. Ongoing work is exploring how to best adapt the probabilistic features across tasks, variants and languages. Exploration of alternative features (Spectrally Reduced Speech, Boosted Binary Features) is underway. To date these features have been investigated for small tasks such as phone recognition, but never validated on larger tasks with a state-of-the-art system.

Research on speech recognition is carried out in a multilingual context, investigating and developing models for a variety of languages and variants. Typically ideas are first explored in one language, with successful methods then transferred to other languages. An example is the incorporation of pitch features in the recognition feature vector, which was first explored for Mandarin Chinese in the context of research for the GALE program, which has since led to improved systems for all languages. The context of the Quaero program, research addresses 9 European languages, with plans to cover all 23 official European languages by the end the program. In this context various approaches for unsupervised training continue to be studied, extending previous work on semi-supervised and unsupervised acoustic model training, and unsupervised language model adaptation is most effective to address task domain mismatch. Unsupervised methods are also being used to address the automatic generation of pronunciations and variants for the English language. The group continues to collaborate with BBN, being a partner on Babelon team (iARPA Babel program) addressing speech recognition and spoken term for low resourced languages. In particular work is exploring the automatic discovery of acoustic and lexical units for speech recognition and multilingual acoustic modeling.

A closely related research topic is language recognition, including language identification (that is identifying the language and/or dialect of an audio document) and language detection. The language recognition research applies the parallel phonotactic approach, with recent studies aimed at the improving estimation of the phonotactic models (exploring various acoustic models, pitch and MLP features, model adaptation), as well as score normalization and fusion. Language recognition is investigated for varied

data types within the context of the Quaero program and for telephone speech, participating in the 2011 NIST organized language recognition evaluation.

Speech recognition is a core technology for processing of audio and audiovisual documents, and is one of the central research topics in the Quaero program, serving for several application projects (Voxalead, Yacast, Orange, Systran OMTP). For such applications, the speech-to-text output must meet two needs: a representation that is easily searchable by machine and a representation that can be easily read by humans. Concerning the latter, reliable punctuation is needed. We are developing algorithms to identify punctuation (periods, question marks, commas, etc.) and disfluency markers, using a combination of language and acoustic/prosodic models (features such as pitch contours, duration, energy, pause lengths, etc). Having a long term goal of developing speech recognition technology that is as good or even better than a human on the same task it important to assess human performance on speech recognition tasks (in collaboration with Topic 3). The human performance serves to provide target performance levels as well as to identify potential technological weaknesses.

Topic 7: Language resources

G. Adda, E. Bilinski, J-J. Gangolf, J.-L. Gauvain, J. Kolar, L. Lamel, J. Mariani, S. Rosset

Statistical models and comparative evaluation have been a driving force in speech processing for over 30 years. Corpora are central to these two major paradigms. While in the past, the use of large corpora has been limited to a few domains and languages, the last decade has witnessed a real expansion towards multilinguality and multimodality. Developing corpora and organizing evaluations are crucial for the language community, and in turn pose scientific problems which need to be solved, such as what corpora to collect and how they should be annotated, as well as scientific questions on how to reward their promoters and how to ensure the ethics in the collection process.

This topic deals with theoretical and practical problems concerning the collection, annotation and diffusion of large multilingual corpora.

The domain of speech processing requires the development of large corpora in order to train and evaluate models. The nature of the data and therefore the type of annotation vary with respect to the type of application: automatic speech recognition requires the collection and normalization of written texts as well as the manual transcription of oral corpora. Translation systems essentially need parallel texts during the training stage whereas annotation using named entities (which consists of marking word groups corresponding to, for example, surnames, first names, dates, units, organizations, etc.) is privileged for interactive information retrieval systems.

Specific problems usually lead to specific corpora. For instance, punctuating speech transcriptions is a controversial subject as many linguists deny the validity of punctuation conventions for spoken language. Nevertheless, punctuating automatic speech transcripts is very useful for many applications. Therefore, to evaluate the automatic production of punctuation for ASR, a 100h multilingual corpus of punctuated speech transcripts was developed along with specific annotation guidelines to maximize the inter-annotator agreement. The evaluation of methods to deals with out-of-vocabulary words (OOV) in ASR is another example: classical corpora contain a very small number of OOV (typically less than 1%) which makes the use of WER inappropriate to compare methods; therefore for the Edylex project a specific corpus of 20h of French and English broadcast news selected containing a high proportion (>4%) of OOVs.

Corpus diversity is equally due to the nature of the data that it contains which is related to the domain of application. For example, texts can be newspaper extracts, transcriptions of European Parliament debates or even taken from blogs. The same is true for the oral corpora: the multiplication of radio, television and Internet media provide easy access to a wide variety of content such as broadcast news shows or conversational broadcasts. In addition, regional broadcasters can offer programs with speakers having numerous accents.

During the preparation of a corpus, this diversity pushes us to precisely define annotation guidelines to guarantee corpus homogeneity. In the case of manual audio transcriptions, the guidelines define, among others, the way to annotate overlapping speech, hesitations or truncated words, but its main purpose is to define how to give a normalized orthographic form to each oral realization. Individual language appendices are written so as to take into account the particularities of each language. Afterwards, the respect of established guidelines during the entire process is often a matter of collaboration between the researchers, the organization responsible for evaluating these systems and the annotators. Techniques such as cross-validation are systematically applied when the number of transcribers allows for it.

Specific tools have been developed with the intention of automating several stages of the processing chain. For the acquisition of oral data, a podcast recording platform was set up which assures the daily recovery of audio files to be transcribed, renames them, and normalizes the signal. After manual transcription, orthography is verified using automatic correction or tools interfaced with online resources. Validation of generated format is equally controlled semi-automatically by scripts. Several methods were experimented with to improve transcription speech, such as correction of texts available on Internet or produced by a recognition system. A different approach to produce fast transcriptions is to apply the partitioner of an automatic speech recognition system to the audio file to be transcribed. This is a very fast step and the approximate time segments output created by the partitioner can be used by transcribers as a starting point.

As part of the Quaero programme, 35 transcribers were hired on fixed-term contracts in order to annotate large multilingual corpora: over 1,700 hours of varied broadcast audio data as well as seminars were manually transcribed. This work concerned 25 different languages of which some are under-resourced, such as Luxembourgish or Lithuanian for which few language resources are nowadays available. These data contribute to the development of automatic speech recognition systems and to the improvement of speaker diarization and for annual evaluations. In collaboration with the ILES group, an extended definition for Named Entities was proposed. These extended Named Entities are hierarchical (with types and components) and compositional (with recursive type inclusion and metonymy annotation). Following these guidelines, two different corpora, one from contemporary broadcast news and the other from old OCRized newspaper (December 1890) have been annotated, each one containing about 1.5 million of words. Because human annotation is an interpretation process, there is no "truth" to rely on. It is therefore impossible to really evaluate the validity of an annotation. All we can do is to evaluate its reliability which is achieved through computation of the inter-annotator agreement (IAA). The best way to compute it is to use one of the Kappa family coefficients, namely Cohen's Kappa or Scott's Pi. However, these coefficients imply a comparison with a "random baseline" which depends on the number of "markables". In the case of Named Entities, this "baseline" is known to be difficult to identify. A study was done, in collaboration with LNE and INIST in which different hypothesis were examined. This study allowed validation of the overall quality of the two corpora which will be made available to the research community.

In addition activities in corpus production, more general investigations on Language Resources (LR) are conducted, where the term "resource" includes data, tools, evaluation and meta-resources (guidelines, methodologies, metadata, Best Practices), for both spoken and written language. Those activities are mostly conducted in connection with the FLaReNet and META-NET European Networks. They address the compilation of LR mentioned in papers presented at conferences (LRE Map), the comparison of the status across languages (Language Matrices and Tables) and the detection of gaps for some languages (Less-Resourced Languages), the unique identification of a LR and the computation of its impact factor. It also concerns the ethical dimension of LR production and distribution in the context of an increase of interest internationally for Data Sharing and Crowdsourcing. In particular, after some preliminary studies concerning the ethical and legal issues of the use of Amazon Mechanical Turk for Language Resource production, a charter of good practice is being developed in collaboration with the AFCP, ATALA, ELRA and other major actors of the domain.

Highlights

- Best ASR system in Evalita evaluation (Nov. 2011)
- Best MT system for English to French translation (WMT 2011, IWSLT 2011)
- Best results REPERE challenge dry-run (2012)
- ACM Multimedia Grand Challenge 2010 award

Staff

Permanent Staff

Firstname	Lastname	Type of position	Employer	HDR	Arrival date	Departure date
Gilles	Adda	Res. Eng.	CNRS	HDR		
Martine	Adda-Decker	DR	CNRS	HDR		Left as of 01/10/2010
Alexandre	Allauzen	Ass. Prof.	U-PSud			

Marianna	Apidianaki	CR	CNRS		Hired as of 01/10/2011	
Claude	Barras	Ass. Prof.	U-PSud	HDR		
Eric	Bilinski	Res. Eng.	CNRS			
Philippe	Boula De Mareüil	CR	CNRS	HDR		
Hervé	Bredin	CR	CNRS		Hired as of 01/09/2010	
Laurence	Devillers	Prof.	Paris IV	HDR		
Jean-Jacques	Gangolf	Res. Eng.	CNRS			
Jean-Luc	Gauvain	DR	CNRS	HDR		
Lori	Lamel	DR	CNRS	HDR		
Joseph-Jean	Mariani	DR	CNRS	HDR		
Hélène	Maynard	Ass. Prof.	U-PSud	HDR		
Sophie	Rosset	CR	CNRS	HDR		
Jean-Luc	Rouas	CR	CNRS		Left as of 31/08/2010	
Ioana	Vasilescu	CR	CNRS			
Guillaume	Wisniewski	Ass. Prof.	U-PSud			
François	Yvon	Prof.	U-PSud	HDR		

PhD Students

Firstname	Lastname	Graduate school	University	Type of support	Start date	Date of defense
Guillaume	Bernard	EDIPS	U-PSud	MNRT PhD grant	01/10/2007	06/06/2011
Théodore	Bluche	EDIPS	U-PSud	CDI A2IA	01/10/2011	
Clément	Chastagnol	EDIPS	U-PSud	CDD CNRS ANR ARMEN	01/01/2010	
Agnès	Delaborde	EDIPS	U-PSud	CDD CNRS ROMEO	04/09/2009	
Nicolas	Foucault	EDIPS	U-PSud	CDD CNRS QUAERO	01/10/2009	
Thiago Henrique	Fraga Da Silva	EDIPS	U-PSud	CDD CNRS QUAERO	01/07/2009	
Souhir	Gahbiche-Braham	EDIPS	U-PSud	CDD CNRS SAMAR	01/11/2009	
Li	Gong	EDIPS	U-PSud	U-PSud PhD grant	01/10/2011	
Panagiota	Karanasou	EDIPS	U-PSud	CDD CNRS QUAERO	01/09/2009	
Hai Son	Le	EDIPS	U-PSud	U-PSud PhD grant	01/10/2009	
Rena	Nemoto	EDIPS	U-PSud	CDD CNRS DIGITEO	01/10/2007	16/11/2011
Mariette	Soury	EDIPS	U-PSud	CDD CNRS E-THERAPIE	01/10/2011	
Marie	Tahon	EDIPS	U-PSud	CDD CNRS ANR COMPARSE	03/02/2009	
Nadi	Tomeh	EDIPS	U-PSud	MNRT PhD grant	01/10/2008	27/06/2012
Christophe	Vaudable	EDIPS	U-PSud	CDD CNRS EPITECH	01/10/2008	

Non permanent staff

Firstname	Lastname	Type of position	Employer	Arrival date	Departure date
Dimitri	Agueev	Support Eng.	CNRS	01/10/2009	30/09/2011
Eukène	Baratze	Support Eng.	CNRS	15/09/2009	30/04/2011
Laura	Batko	Support Eng.	CNRS	01/12/2009	20/01/2010
Mohamed	Benzeghiba	Post-Doc	CNRS	01/04/2008	31/12/2012
Guillaume	Bernard	CDD	CNRS	01/10/2010	31/12/2010
Aurélien	Bossard	Post-Doc	CNRS	01/11/2011	31/10/2012
Carolyn	Bouguet	Support Eng.	CNRS	01/01/2010	30/06/2011
Mathias	Brendel	Post-Doc	CNRS	01/04/2009	31/03/2010

Maria Rosaria	Buffa	Support Eng.	CNRS	01/09/2010	31/08/2011
Maria	Candea	Délégation CNRS	Univ. Paris 3	01/09/2011	28/02/2013
Bruno	Cartoni	Post-Doc	CNRS	01/09/2009	31/08/2010
Valérie	Cazaubon	Support Eng.	CNRS	01/09/2009	31/08/2010
Renata	Champliau	Support Eng.	CNRS	02/08/2010	31/07/2011
Despina Lilian	Chiaruttini	Support Eng.	CNRS	01/12/2009	31/03/2010
Alice	Coutant	Support Eng.	CNRS	01/09/2009	01/09/2011
Josep-Maria	Crego	Post-Doc	CNRS	01/05/2009	15/08/2011
Emmanuel	Didiot	Post-Doc	CNRS	01/02/2010	30/11/2010
Marco	Dinarelli	Post-Doc	CNRS	01/06/2010	30/09/2012
Serigne Fallou	Diouf	Support Eng.	CNRS	01/10/2009	25/01/2010
Cong Thanh	Do	Post-Doc	CNRS	01/11/2011	31/10/2012
Loredana	Draoui	Support Eng.	CNRS	01/09/2010	31/08/2011
Tom	Durand	Support Eng.	CNRS	01/11/2010	31/12/2010
Ilknur	Durgar El Kahlout	Post-Doc	CNRS	01/08/2009	31/07/2010
Judith	Elver	Support Eng.	CNRS	01/01/2010	30/06/2011
Giulia	Garau	Post-Doc	CNRS	01/10/2010	03/03/2011
Jachym	Kolar	Post-Doc	CNRS	01/01/2010	31/12/2012
Krystyna	Kostrzanowska	Support Eng.	CNRS	01/12/2009	30/11/2010
Emilie	Lambert	Support Eng.	CNRS	01/07/2009	30/09/2010
Adrien	Lardilleux	Post-Doc	CNRS	03/10/2010	31/03/2012
Thomas	Lavergne	Post-Doc	CNRS	01/07/2009	31/08/2012
Angélina	Lebedeff	Support Eng.	CNRS	01/09/2009	31/08/2011
Julieta	Lencina	CDD	CNRS	01/07/2010	31/07/2011
Eléna	Lopez Garcia	Collaborateur Extérieur	CNRS	09/02/2009	05/03/2011
Ilaria Libera	Margherita	Visiteur étranger	CNRS	02/05/2011	31/07/2011
Stéphane	Massinon	Support Eng.	CNRS	01/11/2009	09/02/2010
Sha	Meng	Post-Doc	CNRS	01/01/2010	31/12/2010
Abdelkhalek	Messaoudi	Post-Doc	CNRS	01/10/2011	31/03/2013
Virginie	Mouilleron	CDD	CNRS	11/01/2010	31/12/2010
Ilya	Oparin	Post-Doc	CNRS	01/11/2009	30/10/2012
Alise	Ozolina	Support Eng.	CNRS	01/09/2011	15/11/2011
Patty	Pereira	Support Eng.	CNRS	01/07/2009	31/08/2011
Cynthia	Perez De Carvasal	Support Eng.	CNRS	01/11/2010	30/04/2011
Gyula	Rajna	Support Eng.	CNRS	01/10/2011	15/12/2011
Nicolas	Rollet	CDD	CNRS	01/04/2009	31/01/2010
Anindya	Roy	Post-Doc	CNRS	01/12/2011	30/11/2012
Heta	Rundgren	Support Eng.	CNRS	01/09/2009	31/08/2010
Bjorn	Schuller	Post-Doc	CNRS	01/10/2009	31/03/2010
Alassane	Seck	CDD	CNRS	01/11/2009	31/10/2010
Rita	Sidabraite-Brunet	Support Eng.	CNRS	09/11/2009	31/05/2012
Natalie	Snoeren	Post-Doc	CNRS	01/10/2010	20/01/2012
Artem	Sokolov	Post-Doc	CNRS	06/09/2010	31/08/2012
Aija	Sprivul	Support Eng.	CNRS	01/09/2011	31/12/2011
Nadège	Thorez	Administrative Staff	CNRS	01/03/2008	21/12/2012
Viet Anh	Tran	Post-Doc	CNRS	01/02/2010	30/04/2011
Delphine	Tribout	Post-Doc	CNRS	01/01/2010	31/12/2011
Mioara Marcela	Ungureanu	Support Eng.	CNRS	01/12/2011	31/03/2012
Amadeus	Vargas Röhl	Support Eng.	CNRS	01/12/2009	30/11/2010
Beata	Verheyden	Support Eng.	CNRS	01/12/2009	31/05/2011
Lilian	Vieira	Support Eng.	CNRS	01/09/2010	31/08/2011
Christoph	Wagner	Support Eng.	CNRS	01/12/2009	30/11/2011
Sara	Williams	Support Eng.	CNRS	01/12/2009	30/11/2010
Isabelle	Wurth	Support Eng.	CNRS	01/09/2011	30/11/2011
Dahbia	Yahia	Support Eng.	CNRS	01/10/2010	30/06/2011
Qian	Yu	CDD	CNRS	01/10/2011	30/04/2012
Ricardo	Zaccarelli	Post-Doc	CNRS	01/09/2009	31/07/2010
Qing Qing	Zhang	Post-Doc	CNRS	01/08/2010	31/07/2011
Christina	Zikou	Support Eng.	CNRS	05/10/2009	31/05/2011

Indicators of scientific notoriety

Prizes and awards

- Gilles Adda received the CNRS Crystal Medal in 2010 (best engineer distinction) on behalf of the CNRS InSIS Institute.
- J. Mariani was elected ISCA Fellow in 2009.
- J. Mariani was nominated ISCA Life Honorary member in 2010.
- J. Mariani was elected ELRA Honorary President in 2010.

Editorial board appointment

- L. Lamel Speech Communication Editorial Board Member
- L. Lamel Editorial Board of the Journal of Natural Language Engineering (since Jan 2012)
- L, Lamel Advisory Board member of John Benjamin's book series in Natural Language Processing
- J.L. Gauvain Speech Communication Editorial Board Member
- J.L. Gauvain Scientific Advisory Board of Annals of Telecommunications
- J.L. Gauvain Advisory board of I3 Journal
- F. Yvon, editor in chief of the TAL Journal (till July 2010), Editorial board member
- J. Mariani Editorial Board member of the International Journal of Speech Technology (Springer) (1994−)
- J. Mariani Editorial Board member of the "Text, Speech and Language Technology" book series (Springer) (1995−)
- J. Mariani Editorial Board member of the "Language Resources and Evaluation" Journal (Springer) (2004−)
- J. Mariani Member of the Scientific Committee of the TAL 'Language Resources" special issue (2011)
- M. Adda-Decker, Editorial Board member "Computer Speech and Language" (Elsevier) 2009-
- M. Adda-Decker, Editorial Board member "RFLA" 2009-

Organization of international or national scientific events

- J.L Gauvain, Technical Program Committee Interspeech 2010, Brighton
- L. Lamel, Scientific committee Workshop on Spoken Language Technologies for Under-Resourced Languages (SLTU'10), Penang
- L. Lamel, Scientific committee Workshop on Spoken Language Technologies for Under-Resourced Languages (SLTU'12), Cape town
- L. Lamel, Steering Committee, Co-technical chair, Interspeech 2013 (Lyon)
- L. Lamel, Programme Committee Recent Advances in Natural Language Processing (RANLP 2011), Bulgaria
- F. Yvon, Program co-chair, European Conference of the Association for Machine Translation (EAMT'10), Saint Raphaël
- F. Yvon, technical program co-chair, International Workshop on Spoken Language Translation (IWSLT'10), Paris
- G. Adda, I. Vasilescu, Program Committee of XXVIIIe Journées d'Etude sur la Parole (JEP 2010), Mons, Belgium.
- G. Adda, P. Boula de Mareüil, L. Devillers, S. Rosset, Program Committee of XXIXe Journées d'Etude sur la Parole (JEP 2012), Grenoble.
- G. Adda, Program committee AFCP Workshop "Aspects éthiques et juridiques des corpus oraux", 2011, Lyon.
- C. Barras, Scientific committee, Odyssey 2010: The Speaker and Language Recognition Workshop, 2010, Brno.
- C. Barras, Scientific committee, Odyssey 2012: The Speaker and Language Recognition Workshop, 2012, Singapore.
- S. Rosset, Program committee of TALN 2012
- L. Devillers, Program committee 3th International Workshop satellite of LREC 2010 "Corpora for Research on Emotion and Affect", Editors L. Devillers, B. Schuler, R. Cowie, E. Douglas-Cowie, A. Batliner, mai 2010, Malta.
- L. Devillers, Program committee 4th International Workshop satellite of LREC 2012 "Corpora for Research on emotion sentiment & social signals", Editors L. Devillers, B. Schuler, A. Batliner, P. Rosso, R. Cowie, E. Douglas-Cowie, C. Pelachaud, mai 2012, Istanbul.
- L. Devillers, Organizational committee, Interspeech 2013 (Lyon)
- P. Boula de Mareüil, Scientific committee Colloque international La perception des accents du français hors de France, Avignon
- J. Mariani Member of the Program Committee of the LREC'10 conference (Malte, 2010)
- J. Mariani Member of the Program Committee of the LREC'12 conference (Istanbul, 2012)
- J. Mariani Member of the Scientific Committee of the Workshop on Indian Language Data: Resources and Evaluation (WILDRE), Istanbul, May 21, 2012
- J. Mariani Member of the Program Committee of the Workshop on Reinforcing International Collaboration on Language Resources and Evaluation (Coco-FLaRE), Istanbul, May 26, 2012

- J. Mariani Member of the Technical Program Committee, Speech Processing Conference 2011, Tel Aviv, 21-22 June 2011
- J. Mariani Member of the Technical Program Committee, Speech Processing Conference 2012, Tel Aviv, 19-20 June 2012
- J. Mariani General chair of the International Workshop on Spoken Language Translation (IWSLT'10) (Paris, 2010)
- J. Mariani Member of the Steering Committee of the "International Workshop on Spoken Dialog Systems" IWSDS'2010 (Japan, 2010)
- J. Mariani Member of the Steering Committee of the "International Workshop on Spoken Dialog Systems" IWSDS'2011 (Granada, 2011)
- J. Mariani Chair of the Program Committee of the "International Workshop on Spoken Dialog Systems" IWSDS'2012 (Paris, 2012)
- J. Mariani Member of the International Advisory Committee of Oriental Cocosda 2011 Conference (Taiwan, 2011)
- J. Mariani Member of the International Advisory Committee of Oriental Cocosda 2012 Conference (Macau, 2012)
- J. Mariani Member of the Program Committee of the TRALOGY'2011 Conference (Paris, 2011)
- J. Mariani Member of the Program Committee of the TRALOGY'2013 Conference (Paris, 2013)
- J. Mariani Member of the Advisory Committee of the "Etats Généraux du Multilinguisme dans les Outre−Mer" (Cayenne, 2011)
- J. Mariani Member of the Program Committee of the FLaReNet 2010 Forum "Language Resources for the future − The future of Language Resources" (Barcelona, 2010)
- J. Mariani Member of the Program Committee of the FLaReNet 2011 Forum "Language Resources in the Sharing Age − The Strategic Research Agenda" (Venice, 2011)
- J. Mariani Member of the Scientific Committee of the "Language and Technology Conference" (L&TC'11) (Poznan, 2011)
- J. Mariani Co-chair of the "Less-Resourced Languages: Addressing the Gaps in Language Resources and Technologies " Workshop at the "Language and Technology Conference" (L&TC'11) (Poznan, 2011)
- J. Mariani Member of the Scientific Committee of the COLING'2010 Conference (Beijing, 2010)
- J. Mariani Member of the Scientific Committee of the ACIVS'10 Conference (Sydney, 2010)
- J. Mariani Member of the organization committee (in charge of the coordination of the Prospective Committee) of Interspeech 2013 (Lyon) (2011-)

Invited lectures, talks or seminars

Keynote speaker at international conferences

- L. Lamel, invited talk Some Open Challenges for Spoken Language Processing, Chist-era, Cork Sept 6, 2011
- J. Mariani, European Activities in Language Technology, in the perspective of FP8, Speech Processing Conference, Tel Aviv, 21-22 June 2011
- J. Mariani, The Future European Multilingual Society, META-FORUM 2011, Budapest, June 27-28, 2011
- J. Mariani, Closing Remarks, HLT Baltic Conference, Riga, 7-8 October 2010
- J. Mariani, « International Language Resources Mapping », Oriental Cocosda Conference, Katmandhu, 24-25 November 2010
- J. Mariani, Opening remarks, Oriental Cocosda Conference, Hsinchu, Taiwan, 26-28.10.2011
- J. Mariani, Language Technologies in Support to Multilingualism, SIMC'2011, Brasilia, 7-9.11.2011

Invited workshop speaker

- J.L. Gauvain invited talk Spoken language processing for indexing multimedia documents, Content-Based Multimedia Indexing. CBMI 2010, June 25, 2010
- L. Lamel et al, invited paper Speech Recognition for Machine Translation in Quaero, IWSLT, San Francisco, Dec 8, 2011
- J. Mariani, A journey from LRE Map to Language Matrixes, "Language Resources in the Sharing Age - the Strategic Agenda" FLaReNet Forum, Venice, 26-27.05 2011
- J. Mariani, C. Soria, Identifying and networking forces: an international panorama, "Language Resources in the Sharing Age - the Strategic Agenda" FLaReNet Forum, Venice, 26-27.05 2011

Tutorial at workshops or conferences or summer schools

- J. Mariani, Charting the Field to Identify the Gaps in META-VISION, "Less-Resourced Languages: Adressing the Gaps in Language Resources and Technologies " Workshop, "Language and Technology Conference" (L&TC'11) (Poznan, 2011)
- J. Mariani, L'apport des Technologies de la Langue au Multilinguisme, Etats Généraux du Multilinguisme dans les Outre Mer, Cayenne, 14-17 Décembre 2011

Invited talk (national or international)

- J.L. Gauvain, Spoken language technologies for document processing, DGA workshop on speech, language and multimedia document processing, July 6, 2010.
- J.L. Gauvain, Recent Progress in Speech Processing, DGA workshop on Traitement de l'Information Multimédia (TIM'11), July 5, 2011.
- L. Lamel, invited talk on Speech Processing Activities in Quaero at U. Saarbrucken, July 7 2011
- L. Lamel, invited seminar on Speech Processing Activities in Quaero at SRI, Dec 9 2011
- J.L. Gauvain invited talk The QUAERO project and spoken language processing for multimedia search in unstructured data. RWTH, Aachen, Germany, Dec 2, 2011
- J.L. Gauvain, Recent Progress in Speech Processing, DGA workshop on speech, language and multimedia document processing, 2011
- J.L. Gauvain, Quaero: multilingual and multimedia technologies, IWSLT Workskop, 2010 Paris
- F. Yvon, Recent Progress in Machine Translation, DGA workshop on speech, language and multimedia document processing, 2010, 2013
- G. Adda, Using the Amazon Mechanical Turk for the production of Language Resources, FLaReNet Forum 2010, Barcelona, 11-12 Feb 2010
- G. Adda, Language resources and Amazon Mechanical Turk: legal, ethical and other issues, Legal Issues for Sharing Language Resources workshop, Malta, 17 May 2010
- H. Bredin, Video semantic indexing, DGA workshop on speech, language and multimedia document processing, 2010
- L. Devillers, invited talk on Affective and social dimension of spoken interactions, JEFP 2012, June 18 2012
- P. Boula de Mareüil, invited talk on Perception and automatic processing of variation in speech, JEFP 2012, June 18 2012
- P. Boula de Mareüil, invited talk on West-African accents in French, University Paris-Sorbonne-Nouvelle, September 30, 2011
- P. Boula de Mareüil, invited talk on regional accents in French, University of Franche-Comté, December 2, 2010
- J. Mariani, « Speech and Language Technologies Frameworks in the European Research Area», Multisaund seminar, Istanbul, 16-18 June 2010
- J. Mariani, « Presentation of IMMI», Multisaund seminar, Istanbul, 16-18 June 2010
- J. Mariani, « Language resources and evaluation in Europe: an historical perspective », Séminaire DGA/DET/CEP, Paris, 6-7 juillet 2010
- J. Mariani, « IMMI, Quaero, Language Resources and Evaluation », Interact Presidential Summit, Moffett Field, 8-9 November 2010-12-08
- J. Mariani, Presentation of the Interactive Systems Vision Group report, META-Council, Brussels, 16 November 2010
- J. Mariani, LT 2020 Vision Paper. The Future European Multilingual Information Society, META-Council, Venice, 25.05 2011
- J. Mariani, The LT 2020 Vision Paper: The Future European Multilingual Information Society, Multisaund Seminar, Bursa, 13-14 June 2011
- J. Mariani, Ethical Dimension of Crowdsourcing, Special session on Crowdsourcing Panel, Interspeech'2011, Florence, 28-31.08.2011
- J. Mariani, Language Resources, Technologies and Standards in the Sharing Paradigm, in "Strategic Priorities for LT in Europe" LRTS Workshop Panel, IJCNLP'2011, Chiang Mai, 9-13.11.2011
- J. Mariani, Pour une éthique de la recherche en Sciences et Technologies de l'Information et de la Communication, Grand débats éthiques de l'ICT, Toulouse, 17.11.2011
- J. Mariani, LT2020 Vision: Interactive Systems, in "Strategic Priorities for LT in Europe" Panel, LTC'2011, Poznan, 25-27.11.2011

Participation in expertise and administration of research

International or national scientific networking

International networks

- J. Mariani Member of the Board of the Elsnet Foundation (The Netherlands) (1996-)
- J. Mariani Member of the Steering Committee of the FLaReNet Thematic Network (2008-2011)
- J. Mariani Member of the T4ME NoE Management Board (2010-)
- J. Mariani Member of the META-NET Technological Council (2010-)
- J. Mariani Member of the META-NET Executive Board (2011-)
- J. Mariani Coordinator of the META−Net Interactive Systems Vision Group (2010-)
- J. Mariani Member of the META−Net Media and Information Services Vision Group (2010-)
- J. Mariani Member of the META−Net Translation and Localisation Vision Group (2010-)
- J. Mariani Founding Member of the META-TRUST Association (2012-)

National networks or working groups

- G. Adda, I. Vasilescu, P. Boula de Mareuil, A. Allauzen were elected members of the AFCP (Association Francophone de la Communication Parlée) Management Board (2009-2010)
- G. Adda, P. Boula de Mareuil, S. Rosset, L. Devillers are elected members of the AFCP Management Board (2011-2012)
- L. Lamel, ISCA Advisory Council member (2005-2010)
- L. Lamel, Gale data committee chair (May'09-May'10)
- H. Bredin, GdR-ISIS IRIM coordinator
- L. Devillers GT ACAI Affects, Compagnons Artificiels et Interactions (ACAI) du GDR I3, responsible of the axe 2: Detection and synthesis of emotional behavior, annotation and representation from sound, text and image (2012).
- Ph. Boula de Mareuil, L. Devillers, S. Rosset, scientific comittee of the IRCOM (IR Copus Oraux et Multimodaux)

Participation in evaluation or expertise committees

- J.L. Gauvain membre du CoNRS, section 07 (through 2010)
- J. Mariani Member of the CNRS Ethics Committee (COMETS) (2006-2011)
- J. Mariani Coordinator of the COMETS ICT Research Ethics Working Group (2008-2010)
- J. Mariani Member of the COMETS Data Sharing Working Group (2010-2011)
- J. Mariani Member of the CNRS ADONIS TGIR Scientific Committee (2007−2010)

Expert for scientific evaluation committees

- L. Lamel ERA-Net CHIST-ERA Evaluation Panel, Call 2011
- F. Yvon, expert for the evaluation of INRIA teams on "Language, Speech and Audio Processing"
- G. Adda, expert in the International Advisory Panel of Dutch/Flemish Stevin program
- S. Rosset, expert in the Commission Connaissances of Cap Digital
- J. Mariani Expert of the Délégation Générale à la Langue Française et aux Langues de France (DGLFLF) for the creation of a mission on Language Technologies (2011)
- J. Mariani Member of the ENSIEE Scientific Committee (2008-)
- J. Mariani Member of the Institut Télécoms Scientific Committee (2006-2011)
- J. Mariani Member of the Institut National de Recherche et de sécurité (INRS) Scientific Committee (2007-2011)
- J. Mariani Evaluator of the STEVIN Dutch National Program (2010)
- J. Mariani Vice-President of the "Contenu et Interaction" (CONTINT) ANR program Pilot Committee (2007-2010)
- J. Mariani Member of the Evaluation Committee of the DGA−ANR "Carotte" project (2009-2012)
- J. Mariani Member of the ANR CONTINT Project Evaluation Committee (2011)
- J. Mariani Member of the EC High Level researchers in Language Technology Advisory Group (2009-)

Member of the administration or advisory board

- J. Mariani Member of the International Advisory Committee of the MULTISAUND program (Turkey) (2010-)
- J. Mariani Member of the Association Francophone pour la Communication parlée (AFCP) Advisory Committee (2001-)
- J. Mariani Life Member of the ISCA (International Speech Communication Association) International Advisory Committee (2004-)
- J. Mariani Member of the Coordinating Committee on Speech Databases and Speech I/O Systems Assesment (Cocosda) International Advisory Committee (2002-)
- J. Mariani Member of the CESIT−Corsica (Atlas des données toponymiques) Scientific Committee (2009-)
- J. Mariani Member of the RTRA Sciences et Technologies Aéronautique et Espace (STAE) Scientific Committee (2008-2011)
- J. Mariani Member of the Executive Board and Advisory Committee of the Systematic Competitiveness Cluster (2006-2011)
- J. Mariani Member of the ANR Romeo project Societal Committee (2009-)
- J. Mariani Member of the Interministerial Group on Translation (GIT) (2009-)
- J. Mariani Member of the MINEFI Multilingual Innovation Portal Pilot Committee (2009-2010)
- J. Mariani Member of the Allistene Working Group on the Ethics of Research in ICT (2010-)

Member of selection juries

- J. Mariani Referee for the IEEE J.L. Flanagan Speech and Audio Processing Award (2009-2010)
- J. Mariani Member of the ISCA Fellowship Committee (2011-)

Teaching activities and duties in relation to research

- A. Allauzen, C. Barras, L. Devillers, G. Wisniewski, F. Yvon, courses on machine learning and speech recognition, Master 2 level, at: Université Paris-Sud, Telecom ParisTech, Ecole Centrale, Inalco.

- S. Rosset, courses on dialog systems, Master 2 level at University Paris-Sud.

Dissemination and vulgarization

- J.L. Gauvain, Highlight of some CTC activities, Quaero dissemination event, l'Echangeur, Paris, may 2010.
- P. Boula de Mareüil, Interviews for radio shows (RFI, France Inter, RTL...) and daily newspapers (Sud-Ouest, Le Parisien...)
- **J. Mariani**, Interview by P. Testard−Vaillant "De l'éthique pour les STIC», Le Journal du CNRS, n°243, april 2010
- J. Mariani, Pour une éthique de la recherche en Sciences et Technologies de l'Information et de la Communication.», Les cahiers de l'INRIA/La Recherche, n°23, may 2010
- J. Mariani, «Les recherches en Technologies de la Langue pour soutenir le Plurilinguisme», Revue Culture et Communication, Ministère de la Culture et de la Communication, n°124, Winter 2010-2011, january 2011
- J. Mariani, «Les langues face aux nouvelles technologies : traduction automatique, préservation et code informatique», Atelier des Médias, Radio France International, 2 février 2012, http://atelier.rfi.fr/profiles/blogs/expolangues

Research conventions and contracts

Valorization

- Wmatch : an engine and a framework for language analyzer development (Licence Cecill B)
- Ritel-nca : a French multi-level analyzer developed within the Wmatch framework (Licence Cecill B)
- N-code, an n-gram based SMT toolkit (ncode.limsi.fr)
- Wapiti a large-scale CRF package (wapiti.limsi.fr)

Industrial relationships

- EC-FP7 FLaReNet (Fostering Language Resource Network) Thematic Network (J. Mariani, PI) (2008-2011)
- EC-FP7 T4ME (Technologies for a Multilingual Europe) Network of Excellence (J. Mariani, PI) (2010-2013)

Contract table

Acronym	Funding agency/Partner	Program	Nature	Resp. for LIMSI	General coordinator	Starting date	Ending date	LIMSI share
	INA		Licence	Gauvain J.-L.	Gauvain J.-L.	28/02/2002	27/02/2020	
	Vocapia Research		Research collab.	Gauvain J.-L.	Gauvain J.-L.	16/09/2002	03/05/2010	140000
Dactilo	Vecsys/DGA	PEA	Research contract	Gauvain J.-L.	Gauvain J.-L.	01/11/2002	30/09/2013	230000
VITAL	EU	STREP	EU contract	Gauvain J.-L.	Rodriguez T.	01/01/2007	30/09/2010	223132
AMADEO	Digiteo	Projet Emergent	Research collab.	Adda-Decker M.	Adda-Decker M.	01/10/2007	31/12/2010	99804
AFFECTIVE AVATARS	ANR	RNTL	Research collab.	Devillers L.	Devillers L.	01/12/2007	31/03/2010	297704
CROTAL	ANR	MDCO	Research collab.	Yvon F.	Tellier I. (LIFO)	01/01/2008	31/08/2010	61144
QUAERO	OSEO		Research collab.	Gauvain J.-L.	Gauvain J.-L.	01/04/2008	31/12/2013	2993586
Computing Platform	Digiteo	Equipment	Research collab.	Gauvain J.-L.	Gauvain J.-L.	01/07/2008	31/10/2011	1234000
FlareNet	EU	TN	EU contract	Mariani J.-J.	Baroni P. (ILC-CNR)	01/09/2008	31/08/2011	36000
Coencadrement de thèse	EPITECH		Research collab.	Devillers L.	Devillers L.	01/10/2008	30/09/2011	
OTIM	ANR	Basic science	Research collab.	Martin J.-C.	Blache Ph. (LPL)	10/10/2008	30/06/2012	54916
GV-Lex	ANR	CONTINT	Research collab.	d'Alessandro Ch.	Gelin R.(CEA)	15/12/2008	14/06/2012	202807
ROMEO	Région Ile de France	Competitiveness cluster	Research collab.	Devillers L.	Gelin R.(CEA)	01/01/2009	31/12/2012	209000
VOX FACTORY	Région Ile de France	Competitiveness cluster	Research collab.	Gauvain J.-L.	Zenouda G.	01/01/2009	31/12/2010	297541
prêt de corpus	INA	other	Licence	Gauvain J.-L.	Gauvain J.-L.	01/05/2009	30/04/2013	
SAMAR	MEFI	Competitiveness cluster	Research collab.	Yvon F.	Yvon F.	04/05/2009	30/10/2012	208601
SDC	NTU-INL		Licence	Lamel L.	Lamel L.	27/05/2009	27/05/2020	
EDyLex	ANR	CONTINT	Research collab.	Adda G.	Sagot B. (Alpage)	01/11/2009	31/10/2012	181835
TRACE	ANR	CONTINT	Research collab.	Yvon F.	Le Ny B. (Softissimo)	01/11/2009	31/07/2013	205770
ARMEN	ANR	TecSan	Research collab.	Devillers L.	Devillers L.	01/02/2010	30/01/2013	160051
T4ME	EU	REX	EU contract	Mariani J.-J.	Uszkoreit H.(Univ. Saarlandes)	01/02/2010	31/01/2013	536520
H. Ney's Chair	Digiteo	Chair	Research collab.	Gauvain J.-L.	Gauvain J.-L.	01/04/2010	31/03/2013	426000
i2b2 2010	i2b2		Licence	Grouin C.	Grouin C.	01/04/2010	31/03/2011	
prêt de corpus	EDF		Non-disclosure agreem.	Gauvain J.-L.		10/05/2010	31/12/2010	
QCOMPERE	ANR	CONTINT	Research collab.	Barras C.	Barras C.	01/11/2010	31/10/2013	90500
PADE	ANR	JCJC	Research collab.	Rilliard A.	Rilliard A.	15/12/2010	30/11/2014	163512
Google Award	Google		other	Yvon F.	Yvon F.	01/01/2011	31/12/2011	39000
i2b2 2011	UPMC		Licence	Grouin C.	Grouin C.	01/05/2011	30/04/2012	
E-therapies	Région Ile de France	Competitiveness cluster	Research collab.	Devillers L.	Devillers L.	01/09/2011	31/08/2014	134776
	EDF	CIFRE	Research collab.	Rosset S.	Rosset S.	06/12/2011	05/12/2014	45000
IWSLT Corpus	NICT		Licence	Yvon F.	Yvon F.	28/12/2011	03/12/2012	

Scientific publications

Doctoral theses and HDR

T1.   Adda, G., *Approches empiriques et modélisation statistique de la parole*, 2011, HDR de l'Université Paris-Sud, soutenue au LIMSI, Orsay, le 14 novembre 2011. 131 p.

T2.   Barras, C., *Reconnaissance automatique des locuteurs pour la structuration en tours de parole*, 2011, HDR de l'Université Paris-Sud, soutenue au LIMSI, Orsay, le 24 octobre 2011. 80 p.

T3.   Bernard, G., *Réordonnancement d'hypothèses dans un système de questions-réponses* 2011, thèse de l'Université Paris-Sud. Soutenue au LIMSI, Orsay, le 6 juin 2011, 225 p.

T4.   Nemoto, R., *Large-scale acoustic and prosodic investigations of French* 2011, thèse de l'Université Paris–Sud. Soutenue au LIMSI, Orsay, le 16 Novembre 2011, 194 p.

Articles in peer reviewed scientific journals

A1.   Adda-Decker, M. and N. Snoeren, *Quantifying temporal speech reduction in French using forced speech alignment.* Journal of Phonetics, 2011. **39** (3): pp.261-270.

A2.   Batliner, A., S. Steidl, B. Schuller, D. Seppi, T. Vogt, J. Wagner, L. Devillers, L. Vidrascu, V. Aharonson, L. Kessous, and N. Amir, *Whodunnit searching for the most important feature types signalling emotion-related user states in speech.* Computer Speech and Language, 2011. **25** (1): pp.4-18.

A3.   Boula De Mareüil, P. and B.A. Boutin, *Évaluation et identification perceptives d'accents ouest-africains en français.* Journal of French Language Studies, 2011. **21** (3): pp.361-379.

A4.   Boula De Mareüil, P., A. Rilliard, and A. Allauzen, *A diachronic study of initial stress and other prosodic features in the French news announcer style: corpus-based measurements and perceptual experiments.* Language and Speech, 2011. pp.1-31.

A5.   Clavel, C., I. Vasilescu, and L. Devillers, *Fiction supports for realistic portrayals of fear-type emotional manifestations.* Computer Speech and Language, 2011. **25** (1): pp.63-83.

A6.   Crego, J.-M., G. Leusch, A. Max, H. Ney, and F. Yvon, *Micro-adaptation lexicale en traduction automatique statistique.* TAL (Traitement Automatique des Langues), 2010. **51** (2): pp.65-93.

A7.   Crego, J.-M. and F. Yvon, *Factored bilingual n-gram language models for statistical machine translation.* Machine Translation, 2010. **24** (2): pp.159-175.

A8.   Crego, J.-M., F. Yvon, and J.B. Mariño, *N-code: an open-source Bilingual N-gram SMT Toolkit.* Prague Bulletin of Mathematical Linguistics, 2011. **96**: pp.49-58.

A9.   Ferras, M., C.C. Leung, C. Barras, and J.-L. Gauvain, *Comparison of speaker adaptation methods as feature extraction for SVM-based Speaker Recognition.* IEEE Transactions on Audio, Speech and Language Processing, 2010. **18** (6): pp.1366-1378.

A10.   Fort, K., G. Adda, and K. Bretonnel-Cohen, *Amazon mechanical Turk: gold mine or coal mine?* Computational Linguistics, 2011. **37** (2): pp.413-420.

A11.   Lardilleux, A., Y. Lepage, and F. Yvon, *The contribution of low frequencies to multilingual sub-sentential alignment: a differential associative approach.* International Journal of Advanced Intelligence, 2011. **3** (2): pp.189-217.

A12.   Lavergne, T., T. Urvoy, and F. Yvon, *Filtering artificial texts with statistical machine learning techniques.* Language Resources and Evaluation, 2011. **45** (1): pp.25-43.

A13.   Minard, A.-L., A.-L. Ligozat, A. Ben Abacha, D. Bernhard, B. Cartoni, L. Deléger, B. Grau, S. Rosset, P. Zweigenbaum, and C. Grouin, *Hybrid methods for improving information access in clinical documents: concept, assertion, and relation identification.* Journal of the American Medical Information Association (JAMIA), 2011. **18** (5): pp.588-593.

A14.   Misra, H., F. Yvon, J. Jose, and O. Cappé, *Text segmentation: a topic modeling perspective.* Information Processing & Management, 2011. **47** (4): pp.528-544.

A15.   Quénot, G., T. Tan, V.B. Le, S. Ayache, L. Besacier, and P. Mulhem, *Content-based search in multilingual audiovisual documents using the international phonetic alphabet.* Multimedia Tools and Applications, 2010. **48** (3): pp.123-140.

A16.   Sokolovska, N., T. Lavergne, O. Cappé, and F. Yvon, *Efficient learning of sparse conditional random fields for supervised sequence labeling.* IEEE Journal of Selected Topics in Signal Processing - Special Issue on Statistical Learning Methods for Speech and Language Processing, 2010. **4** (6): pp.953-964.

A17.   Torreira, F., M. Adda-Decker, and M. Ernestus, *The nijmegen corpus of casual French.* Speech Communication, 2010. **52** (3): pp.201-212.

A18.   Vieru-Dimulescu, B., P. Boula De Mareüil, and M. Adda-Decker, *Identification and characterisation of non-native French accents.* Speech Communication, 2011. **53** (3): pp.292-310.

A19.   Yvon, F., *Rewriting the orthography of SMS messages.* Natural Language Engineering, 2010. **16** (2): pp.133-159.

Books & chapters in books

B1.   Adda, G., F. Cailliau, A. Daquo, M. Garnier-Rizet, S. Guillemin-Lanne, P. Suignard, and C. Waast-Richard, *La transcription automatique et la fouille de données conversationnelles pour l'analyse de la relation client*, in *Sémantique et multimodalité en analyse de l'information*, M. Campedel and P.

Hoogstoël, Eds. 2011, Hermès. pp. 215-250.

B2. Adda, G., G. Chollet, S. Essid, T. Fillon, M. Garnier-Rizet, C. Hory, and L. Beltaifa-Zouari, *Traitement des modalités*, in *Sémantique et multimodalité en analyse de l'information*, M. Campedel and P.E. Hoogstoël, Eds. 2011, Hermès. pp. 143-188.

B3. Allauzen, A. and F. Yvon, *Méthodes statistiques pour la traduction automatique*, in *Modèles statistiques pour l'accès à l'information textuelle. Chap 7*, E. Gaussier and F. Yvon, Eds. 2011, Hermès. pp. 271-356.

B4. Batliner, A., B. Schuller, D. Seppi, S. Steidl, L. Devillers, L. Vidrascu, T. Vogt, V. Aharonson, and N. Amir, *The automatic recognition of emotions in speech*, in *Emotion-oriented systems: the Humaine handbook*, P. Petta, C. Pelachaud, and R. Cowie, Eds. 2011. pp. 71-99.

B5. Boula De Mareüil, P., *D'où viennent les accents régionaux?* 2010: Le Pommier. 63pp.

B6. Cowie, R., E. Douglas-Cowie, J.-C. Martin, and L. Devillers, *The essential role of human databases for learning in and validation of affectively competent agents*, in *Blueprint for Affective Computing. A sourcebook*, K.R. Scherer, T. Banziger, and E. Roesch, Eds. 2010, Oxford University Press. pp. 151-165.

B7. Devillers, L. and J.-C. Martin, *Corpus émotionnels : de l'acquisition à la modélisation*, in *Systèmes d'interaction émotionnelle (Traité signal et image, IC2)*, C. Pelachaud, Ed. 2010, Hermès Science. chap 3.

B8. Devillers, L., L. Vidrascu, and O. Layachi, *Automatic detection of emotion from vocal expression*, in *A Blueprint for affective computing: a sourcebook and manual*, K.R. Scherer, T. Banziger, and E. Roesch, Eds. 2010, Oxford University Press. pp. 232-244.

B9. Douglas-Cowie, E., C. Cox, J.-C. Martin, L. Devillers, R. Cowie, I. Sneddon, M. McRorie, C. Pelachaud, C. Peters, O. Lowry, A. Batliner, and F. Hönig, *The HUMAINE database*, in *Emotion-oriented systems: the humaine handbook*, P. Petta, C. Pelachaud, and R. Cowie, Eds. 2011, Springer. pp. 243-286.

B10. Federico, M., I. Lane, M. Paul, F. Yvon, and J.-J. Mariani, *Proceedings of the International Workshop on Spoken Language Translation (IWSLT'2010)* 2010: Paris, France. 100p.

B11. Fousek, P., L. Lamel, and J.-L. Gauvain, *Combining MLP and PLP features for speech transcription*, in *Handbook of natural language processing and machine translation: DARPA global autonomous language exploitation*, J. Olive, C. Christianson, and J. McCary, Eds. 2011, Springer. pp. 408-416.

B12. Galibert, O., S. Rosset, and L. Lamel, *Questions-réponses sur des documents audio*, in *Recherche d'information contextuelle, assistée et personnalisée (Chap. 4)*, P. Bellot, Editor. 2011, Hermès--Lavoisier. pp. 99-124.

B13. Gaussier, E. and F. Yvon, *Modèles statistiques pour l'accès à l'information textuelle* 2011: Hermès. 482pp.

B14. Hallé, P. and M. Adda-Decker, *Voice assimilation in French obstruents: A gradient or a categorical process?*, in *Tones and features: A festschrift for Nick Clements*, J.A. Goldsmith, E. Hume, and L. Wetzels, Eds. 2011, De Gruyter. pp. 149-175.

B15. Lamel, L., A. Messaoudi, and J.-L. Gauvain, *Explicit and implicit modeling of short vowels for Arabic STT*, in *Handbook of natural language processing and machine translation: DARPA global autonomous language exploitation (Chap. 3.6.2)*, J. Olive, C. Christianson, and J. McCary, Eds. 2011, Springer. pp. 523-528.

B16. Lee, G., J.-J. Mariani, W. Minker, and S. Nakamura, *Spoken dialogue systems for ambient environments* 2010: Springer. 199p.

B17. Marotta, G. and P. Boula De Mareüil, *Persistenza dell'accento straniero. Uno studio percettivo sull'italiano L2*, in *La dimensione temporale del parlato*, S. Schmid, M. Schwarzenbach, and D. Studer, Eds. 2010, EDK Editore. pp. 475-494.

B18. Martin, J.-C., L. Devillers, A. Raouzaiou, G. Caridakis, Z. Ruttkay, C. Pelachaud, M. Mancini, R. Niewiadomski, H. Pirker, B. Krenn, I. Poggi, E. Caldognetto, F. Cavicchio, G. Merola, A. Garcia Rojas, and F. Vexo, *Coordinating the generation of signs in multiple modalities in an affective agent*, in *Emotion-oriented systems: the humaine handbook*, P. Petta, C. Pelachaud, and R. Cowie, Eds. 2011, Springer. pp. 349-368.

B19. Matsoukas, S., B. Zhang, J. Ma, T. Ng, L. Nguyen, F. Diehl, M. Gales, X. Liu, J. Park, M. Tomalin, P. Woodland, P. Fousek, J.-L. Gauvain, L. Lamel, J. Luo, and A. Messaoudi, *Optimizing Speech-to-Text System Combination for Machine Translation*, in *Handbook of natural language processing and machine translation: DARPA global autonomous language exploitation (Chap. 3.7.4)*, J. Olive, C. Christianson, and J. McCary, Eds. 2011, Springer. pp. 590-597.

B20. Minker, W., G. Lee, S. Nakamura, and J.-J. Mariani, *Spoken dialogue systems technology and design* 2011: Springer. 277pp.

B21. Rosset, S., O. Galibert, and L. Lamel, *Spoken question answering*, in *Spoken language understanding: systems for extracting semantic information from speech*, T. Gokhan and M. Renato De, Eds. 2011, Wiley. pp. Chap 6.

B22. Schwenk, H., A. Messaoudi, J. Luo, and J.-L. Gauvain, *On the use of Continuous Space Neural Network Language Models*, in *Handbook of natural language processing and machine translation: DARPA global*

autonomous language exploitation (Chap. 3.4.2), J. Olive, C. Christianson, and J. McCary, Eds. 2011, Springer. pp. 460-467.

B23. Vasilescu, I., *Perception et reconnaissance des émotions*, in *Systèmes d'interaction émotionnelle (Traité signal et image, IC2)*, C. Pelachaud, Editor. 2010, Hermès Science. pp. 223-245.

B24. Vasilescu, I., *Emotion perception and recognition*, in *Emotion-oriented systems*, C.T.P.F. Catherine Pelachaud, Editor. 2011, J. Wiley. pp. 191-209.

B25. Vetulani, Z. and J.-J. Mariani, *Preface*, in *Human Language Technology for Computer Sciences and Linguistics*, Z. Vetulani, Editor. 2011, Springer Verlag. pp. 5-11.

B26. Waibel, A., R. Stiefelhagen, R. Carlson, J. Casas, J. Kleindienst, L. Lamel, O. Lanz, D. Mostefa, M. Omologo, F. Pianesi, L. Polymenakos, G. Potamianos, J. Soldatos, G. Sutschet, and J. Terken, *Computers in the human interaction loop*, in *Handbook on ambient intelligence and smart environments*, H. Nakashima, H. Aghajan, and J.C. Augusto, Eds. 2010, Springer. pp. 1071-1116.

B27. Yvon, F., *Introduction aux modèles probabilistes pour la fouille de textes*, in *Modèles statistiques pour l'accès à l'information textuelle*, E. Gaussier and F. Yvon, Eds. 2011, Hermès. pp. 423-477.

B28. Yvon, F. and V. Hansen, *Proceedings of the 14th annual conference of the European Association for Machine Translation*. Vol. http://www.mt-archive.info/EAMT-2010-TOC.htm. 2010.

Conferences with proceedings and review committee

C1. Adda, G., B. Sagot, K. Fort, and J.-J. Mariani. *Crowdsourcing for language resource development: critical analysis of amazon mechanical turk overpowering use*. in *Language & Technology Conference : Human Language Technologies as a Challenge for Computer Science and Linguistics*. 2011. Poznan, Poland. 304-308.

C2. Adda-Decker, M., L. Lamel, and G. Adda. *A first LVCSR system for Luxembourgish, an under-resourced European language*. in *Language & Technology Conference : Human Language Technologies as a Challenge for Computer Science and Linguistics*. 2011. Poznan, Poland. 47-50.

C3. Adda-Decker, M., L. Lamel, and N. Snoeren. *Initializing acoustic phone models of under-resourced languages : a case-study of Luxembourgish*. in *International Workshop on Spoken Languages Technologies for Under-resourced languages*. 2010. Penang, Malaysia. 74-80.

C4. Adda-Decker, M., L. Lamel, and N. Snoeren. *Comparing mono-& multilingual acoustic seed models for a low e-resourced language: a case-study of Luxembourgish*. in *Annual Conference of the International Speech Communication Association*. 2010. 10p.

C5. Adda-Decker, M., L. Lamel, and N. Snoeren. *Studying Luxembourgish phonetics via multilingual forced alignments*. in *International Congress of Phonetic Sciences*. 2011. Hong Kong, China. 196-199.

C6. Adda-Decker, M., I. Vasilescu, N. Snoeren, N. Yahia, and L. Lamel. *Towards exploring linguistic variation in ASR errors: paradigm and tool for perceptual experiments*. in *Workshop : New Tools and Methods for Very-Large-Scale Phonetics Research*. 2011. Philadelphia, USA. 4p.

C7. Allauzen, A., J.-M. Crego, I. Durgar El Khalout, H.S. Le, G. Wisniewski, and F. Yvon. *LIMSI @ IWSLT 2010*. in *International Workshop on Spoken Language Translation*. 2010. Paris, France. 105-112.

C8. Allauzen, A., J.-M. Crego, I. Durgar El Khalout, and F. Yvon. *LIMSI's statistical translation systems for WMT'10*. in *Workshop on Statistical Machine Translation*. 2010. Uppsala, Sweden. 54-59.

C9. Benzeghiba, M., J.-L. Gauvain, and L. Lamel. *Improved N-gram phonotactic models for language recognition*. in *Annual Conference of the International Speech Communication Association*. 2010. Makuhari, Japan. 4p.

C10. Bernard, G., S. Rosset, M. Adda-Decker, and O. Galibert. *A question-answer distance measure to investigate QA system progress*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 6p.

C11. Boula De Mareüil, P., M. Adda-Decker, and C. Woehrling. *Antériorisation / aperture des voyelles //~/o/ en français du nord et du sud*. in *Journées d'Etude sur la Parole*. 2010. Mons, Belgique. 4p.

C12. Boula De Mareüil, P. and A. Bardiaux. *Perception of French, Belgian and Swiss accents by French and Belgian listeners*. in *ISCA Tutorial and Research Workshop on Experimental Linguistics*. 2011. Paris, France. 47-50.

C13. Boula De Mareüil, P. and I. Lehka-Lemarchand. *Can a prosodic pattern induce/reduce the perception of a lower-class suburban accent in French?* in *International Congress of Phonetic Sciences*. 2011. Hong Kong, People's Republic of China. 348-351.

C14. Boula De Mareüil, P., J.-L. Rouas, and M. Yapomo Domkem. *In search of cues discriminating West-African accents in French*. in *Annual Conference of the International Speech Communication Association*. 2011. Florence, Italy. 725-728.

C15. Brendel, M., R. Zaccarelli, and L. Devillers. *Building a system for emotions detection from speech to control an affective avatar*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 5p.

C16.   Brendel, M., R. Zaccarelli, and L. Devillers. *A Quick Sequential Forward Floating Feature Selection Algorithm for Emotion Detection from Speech*. in *Annual Conference of the International Speech Communication Association*. 2010. Makuhari, Chiba, Japan. 1157-1160.

C17.   Brendel, M., R. Zaccarelli, B. Schuller, and L. Devillers. *Towards measuring similarity between emotional corpora*. in *International Workshop on EMOTION : Corpora for Research on Emotion Affect*. 2010. Valetta, Malta. 5p.

C18.   Calzolari, N., C. Soria, R. Del Gratta, S. Goggi, V. Quochi, I. Russo, K. Choukri, J.-J. Mariani, and S. Piperidis. *The LREC 2010 resource map*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 6p.

C19.   Chastagnol, C. and L. Devillers. *Analysis of Anger across several agent-customer interactions in French call centers*. in *IEEE International Conference on Acoustics, Speech and Signal Processing*. 2011. Prague, Czech Republic. 4960-4963.

C20.   Clavel, C., L. Devillers, and J.-C. Martin. *Combinaisons d'expressions vocales, faciales et posturales des émotions chez un agent animé : ce que perçoivent les utilisateurs*. in *4ème Workshop sur les Agents Conversationnels Animés (WACA 2010)*. 2010: Université Lille I. 8p.

C21.   Crego, J.-M., A. Max, and F. Yvon. *Local lexical adaptation in machine translation through triangulation: SMT helping SMT*. in *International Conference on Computational Linguistics*. 2010. Beijing, China. 232-240.

C22.   Crego, J.-M. and F. Yvon. *Improving reordering with linguistically informed bilingual n-grams*. in *International Conference on Computational Linguistics*. 2010. Beijing, China. 197-205.

C23.   Delaborde, A. and L. Devillers. *Use of nonverbal speech cues in social interaction between human and robot: emotional and interactional markers*. in *3rd ACM Workshop on Affective Interaction in Natural Environments (AFFINE 2010)*. 2010: ACM.

C24.   Delaborde, A., M. Tahon, and L. Devillers. *Affective links in a child-robot interaction*. in *International Workshop on EMOTION : Corpora for Research on Emotion Affect*. 2010. Valetta, Malta. 5p.

C25.   Devillers, L., C. Vaudable, and C. Chastagnol. *Real-Life Emotion-Related States Detection in Call Centers: A Cross-Corpora Study*. in *Annual Conference of the International Speech Communication Association*. 2010. Makuhari, Chiba, Japan. 2350-2353.

C26.   Dinarelli, M. and S. Rosset. *Models cascade for tree-structured named entity detection*. in *International Joint Conference on Natural Language Processing*. 2011. Chiang Mai, Thailand. 1269-1278.

C27.   Doukhan, D., A. Rilliard, S. Rosset, M. Adda-Decker, and C. D'Alessandro. *Prosodic analysis of a corpus of tales*. in *Annual Conference of the International Speech Communication Association*. 2011. Firenze, Italy: ISCA - ISSN 1990-9772. 3129-3132.

C28.   Durgar El Khalout, I. and F. Yvon. *The pay-offs of preprocessing for German-English statistical machine translation*. in *International Workshop on Spoken Language Translation*. 2010. Paris, France. 251-258.

C29.   El Maarouf, I., J. Villaneau, and S. Rosset. *Extraction de patrons sémantiques appliquée à la classsification d'entités nommées*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2011. Montpellier, France. 173-184.

C30.   Ercolessi, P., H. Bredin, C. Sénac, and P. Joly. *Segmenting TV series into scenes using speaker diarization*. in *International Workshop on Image Analysis for Multimedia Interactive Services*. 2011. Delft, The Netherlands. 4p.

C31.   Foucault, N., G. Adda, and S. Rosset. *Language modeling for document selection in question answering*. in *Recent Advances in Natural Language Processing*. 2011. Hissar, Bulgaria: RANLP 2011 Organising Committee. 716-720.

C32.   Fraga-Silva, T., J.-L. Gauvain, and L. Lamel. *Lattice-based unsupervised acoustic model training*. in *IEEE International Conference on Acoustics, Speech and Signal Processing*. 2011. Prague, Czech Republic. 4656-4659.

C33.   Gahbiche-Braham, S., H. Bonneau-Maynard, and F. Yvon. *Two ways to use a noisy parallel news corpus for improving statistical machine translation*. in *Workshop on Building and Using Comparable Corpora: Comparable Corpora and the Web - Co-located with ACL-HLT*. 2011. Portland, USA. 44-51.

C34.   Galibert, O., L. Quintard, S. Rosset, P. Zweigenbaum, C. Nedellec, S. Aubin, L. Gillard, J. Raysz, D. Pois, X. Tannier, L. Deléger, and D. Laurent. *Named and specific entity detection in varied data : the Quaero named entity baseline evaluation*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 6p.

C35.   Galibert, O., S. Rosset, C. Grouin, P. Zweigenbaum, and L. Quintard. *Structured and extended named entity evaluation in automatic speech transcriptions*. in *International Joint Conference on Natural Language Processing*. 2011. Chiang Mai, Thailand. 518-526.

C36.   Galibert, O., S. Rosset, X. Tannier, and F. Grandry. *Hybrid citation extraction from patents*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 5p.

C37.   Garcia-Fernandez, A., A.-L. Ligozat, M. Dinarelli, and D. Bernhard. *When was it written? Automatically determining publication dates*. in *International Symposium on String Processing and Information Retrieval*. 2011. Pise, Italie. 12p.

C38.   Garcia-Fernandez, A., S. Rosset, and A. Vilnat. *MACAQ : A multi annotated corpus to study how we adapt answers to various questions*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 7p.

C39.   Garcia-Fernandez, A., S. Rosset, and A. Vilnat. *Comment formule-t-on une réponse en langue naturelle?* in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2010. Montréal, Canada. 10p.

C40.   Garcia-Fernandez, A., I. Vasilescu, and S. Rosset. *Euh as cue for speaker confidence and word searching in human spoken answers in French*. in *Workshop on Disfluency in Spontaneous Speech - The 2nd International Symposium on Linguistic Patterns in Spontaneous Speech*. 2010. Tokyo, Japan. 2p.

C41.   Grouin, C., M. Dinarelli, S. Rosset, G. Wisniewski, and P. Zweigenbaum. *Coreference resolution in clinical reports. The LIMSI participation in the i2b2/VA 2011 Challenge*. in *i2b2/VA Challenge*. 2011: i2b2 / VA. 1-10.

C42.   Kaglik, A. and P. Boula De Mareüil. *Polish-accented French prosody in perception and production : transfer or universal acquisition process?* in *International Conference on Speech Prosody*. 2010. Chicago, USA. 4p.

C43.   Karanasou, P. and L. Lamel. *Comparing SMT methods for automatic generation of pronunciation variants*. in *International Conference on Natural Language Processing*. 2010. Reykjavik, Iceland. 167-178.

C44.   Karanasou, P. and L. Lamel. *Pronunciation variants generation using SMT-inspired approaches*. in *IEEE International Conference on Acoustics, Speech and Signal Processing*. 2011. Prague, Czech Republic: IEEE. 4908-4911.

C45.   Karanasou, P. and L. Lamel. *Automatic Generation of a Pronunciation Dictionary with Rich Variation Coverage Using SMT Methods*. in *International Conference on Intelligent Text Processing and Computational Linguistics*. 2011. Tokyo, Japan: Springer. 506-517.

C46.   Karanasou, P., F. Yvon, and L. Lamel. *Measuring the Confusability of Pronunciations in Speech Recognition*. in *International Workshop on Finite State Methods and Natural Language Processing*. 2011. Tours, France. 107-115.

C47.   Kolar, J. and L. Lamel. *On development of consistently punctuated speech corpora*. in *Annual Conference of the International Speech Communication Association*. 2011. Florence, Italy. 4p.

C48.   Kolar, J. and Y. Liu. *Comparing and combining modeling techniques for sentence segmentation of spoken Czech using textual and prosodic information*. in *International Conference on Speech Prosody*. 2010. Chicago, USA. 4p.

C49.   Lamel, L., J.-L. Gauvain, V.B. Le, I. Oparin, and S. Meng. *Improved models for Mandarin speech-to-text transcription*. in *IEEE International Conference on Acoustics, Speech and Signal Processing*. 2011. Prague, Czech Republic. 4660-4663.

C50.   Lamel, L. and B. Vieru-Dimulescu. *Development of a speech-to-text transcription system for finnish*. in *International Workshop on Spoken Languages Technologies for Under-resourced languages*. 2010. Penang, Malaysia. 62-67.

C51.   Lardilleux, A., F. Yvon, and Y. Lepage. *Généralisation de l'alignement sous-phrastique par échantillonnage*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2011. Montpellier, France. 13p.

C52.   Lavergne, T., A. Allauzen, J.-M. Crego, and F. Yvon. *From n-gram-based to CRF-based translation models*. in *Workshop on Statistical Machine Translation*. 2011. Edimburgh, Scotland. 542--553.

C53.   Lavergne, T., O. Cappé, and F. Yvon. *Practical very large scale CRFs*. in *Annual Meeting of the Association for Computational Linguistics*. 2010. Uppsala, Sweden. 504-513.

C54.   Lavergne, T., H.S. Le, A. Allauzen, and F. Yvon. *LIMSI's experiments in domain adaptation for IWSLT11*. in *International Workshop on Spoken Language Translation*. 2011. San Francisco, USA: Hwang, Mei-Yuh and Stüker, Sebastian. 8p.

C55.   Law-To, J., G. Grefenstette, J.-L. Gauvain, L. Lamel, and J. Despres. *A scalable video search engine based on audio content indexing and topic segmentation*. in *Annual Networked Electronic Media Summit*. 2011. Turin, Italy. 6p.

C56.   Le, H.S., A. Allauzen, G. Wisniewski, and F. Yvon. *Training continuous space language models: some practical issues*. in *Conference on Empirical Methods in Natural Language Processing*. 2010. Cambridge, USA. 778-788.

C57.   Le, H.S., I. Oparin, A. Allauzen, J.-L. Gauvain, and F. Yvon. *Structured output layer neural network language model*. in *IEEE International Conference on Acoustics, Speech and Signal Processing*. 2011. Prague, Czech Republic. 5524-5527.

C58.   Le, H.S., I. Oparin, A. Messaoudi, A. Allauzen, J.-L. Gauvain, and F. Yvon. *Large vocabulary SOUL neural network language models*. in *Annual Conference of the International Speech Communication Association*. 2011. Florence, Italy. 1469-1472.

C59.   Le, V.B., C. Barras, and M. Ferras. *On the use of GSV-SVM for speaker diarization and tracking*. in *The Speaker and Language Recognition Workshop*. 2010. Brno, Czech Republic. 146-150.

C60. Le, V.B., L. Lamel, and J.-L. Gauvain. *Multi-style MLP features for BN transcription*. in *IEEE International Conference on Acoustics, Speech and Signal Processing*. 2010. Dallas, USA. 4p.

C61. Liénard, J.-S., C. Barras, and F. Signol. *Time structure and detection of the multivoiced segments in mixed speech*. in *International Congress of Phonetic Sciences*. 2011. Hong Kong, China. 1234-1237.

C62. Max, A., J.-M. Crego, and F. Yvon. *Contrastive lexical evaluation of machine translation*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 5p.

C63. Max, A. and G. Wisniewski. *Mining naturally-occurring corrections and paraphrases from Wikipedia's revision history*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 6p.

C64. Misra, H. and F. Yvon. *Modèles thématiques pour la segmentation de documents*. in *International Conference Journées d'Analyse statistique des Données Textuelles*. 2010. Rome, Italie. 203-213.

C65. Moreau, N., O. Hamon, D. Mostefa, S. Rosset, O. Galibert, L. Lamel, J. Turmo, P. Comas, P. Rosso, D. Buscaldi, and K. Choukri. *Evaluation protocol and tools for question-answering on speech transcripts*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 6p.

C66. Nemoto, R., M. Adda-Decker, and J. Durand. *Investigation of lexical f0 and duration patterns in French using large broadcast news speech corpora*. in *International Conference on Speech Prosody*. 2010. Chicago, USA. 4p.

C67. Nemoto, R., M. Adda-Decker, and J. Durand. *Démarcation lexicale en français : profils prosodiques sur grand corpus*. in *Journées d'Etude sur la Parole*. 2010. Mons, Belgique. 237-240.

C68. Nemoto, R., M. Adda-Decker, and J. Durand. *Word boundaries in French: Evidence from large speech corpora*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 3272-3277.

C69. Oparin, I., L. Lamel, and J.-L. Gauvain. *Large-scale language modeling with random forests for Mandarin Chinese speech-to-text*. in *International Conference on Natural Language Processing*. 2010. Reykjavik, Iceland. 269-280.

C70. Oparin, I., L. Lamel, and J.-L. Gauvain. *Improving Mandarin Chinese STT system with random forests language models*. in *International Symposium on Chinese Spoken Language Processing*. 2010. Tainan, Taiwan. 242-245.

C71. Quintard, L., O. Galibert, D. Laurent, S. Rosset, G. Adda, V. Moriceau, X. Tannier, B. Grau, and A. Vilnat. *Question answering on web data : the QA evaluation in Quaero*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 7p.

C72. Rilliard, A., A. Allauzen, and P. Boula De Mareüil. *Using dynamic time warping to compute prosodic similarity measures*. in *Annual Conference of the International Speech Communication Association*. 2011. Florence, Italy. 2021-2024.

C73. Rouas, J.-L., M. Beppu, and M. Adda-Decker. *Comparison of spectral properties of read, prepared and casual speech in French*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 6p.

C74. Rouas, J.-L., M. Beppu, and M. Adda-Decker. *Comparaison des propriétés acoustiques de la parole lue, préparée et conversationnelle en français*. in *Journées d'Etude sur la Parole*. 2010. Mons, Belgique. 4p.

C75. Sagot, B., K. Fort, G. Adda, J.-J. Mariani, and B. Lang. *Un turc mécanique pour les ressources linguistiques : critique de la myriadisation du travail parcellisé*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2011. Montpellier, France. 199-210.

C76. Schuller, B. and L. Devillers. *Incremental Acoustic Valence Recognition: An Inter-Corpus Perspective on Features, Matching, and Performance in a Gating Paradigm*. in *Annual Conference of the International Speech Communication Association*. 2010. Makuhari, Chiba, Japan. 801-804.

C77. Schuller, B., S. Steidl, A. Batliner, F. Burkhardt, L. Devillers, C. Müller, and S. Narayanan. *The INTERSPEECH 2010 paralinguistic challenge*. in *Annual Conference of the International Speech Communication Association*. 2010. Makuhari, Japan. 2794-2797.

C78. Schuller, B., R. Zaccarelli, N. Rollet, and L. Devillers. *CINEMO - A French spoken language resource for complex emotions : facts and baselines*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 5p.

C79. Signol, F., J.-S. Liénard, and C. Barras. *Influence de la décision voisé/non-voisé dans l'évaluation comparative d'algorithmes d'estimation de F0*. in *Journées d'Etude sur la Parole*. 2010. Mons, Belgique. 4p.

C80. Snoeren, N., M. Adda-Decker, and G. Adda. *The study of writing variants in an under-resourced language: some evidence from Mobile N-Deletion in Luxembourgish*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 5p.

C81. Sokolov, A., T. Urvoy, and H.S. Le. *Low-dimensional feature learning with Kernel construction*. in *NIPS 2011 Workshop on Deep Learning and Unsupervised Feature Learning*. 2011: NIPS. 1-9.

C82. Sokolov, A. and F. Yvon. *Minimum error rate semi-ring*. in *Annual Conference of the European Association for Machine Translation*. 2011. Leuven, Belgium. 241-248.

C83.   Tahon, M., A. Delaborde, C. Barras, and L. Devillers. *A corpus for identification of speakers and their emotions*. in *International Workshop on EMOTION : Corpora for Research on Emotion Affect*. 2010. Valetta, Malta. 5p.

C84.   Tahon, M., A. Delaborde, and L. Devillers. *Real-life emotion detection from speech in human-robot interaction: experiments across diverse corpora with child and adult voices*. in *Annual Conference of the International Speech Communication Association*. 2011. Florence, Italy. 3121-3124.

C85.   Tahon, M. and L. Devillers. *Acoustic measures characterizing anger across corpora collected in artificial or natural context*. in *International Conference on Speech Prosody*. 2010. Chicago, USA. 4p.

C86.   Tomeh, N., A. Allauzen, T. Lavergne, and F. Yvon. *Designing an improved discriminative word aligner*. in *International Conference on Intelligent Text Processing and Computational Linguistics*. 2011. Tokyo, Japan. 12p.

C87.   Tomeh, N., A. Allauzen, G. Wisniewski, and F. Yvon. *Refining word alignment with discriminative training*. in *Conference of the Association for Machine Translation in the Americas*. 2010. Denver, USA. 10p.

C88.   Tomeh, N., A. Allauzen, and F. Yvon. *Estimation d'un modèle de traduction à partir d'alignements mot-à-mot non-déterministes*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2011. Montpellier, France. 12p.

C89.   Tomeh, N., A. Allauzen, and F. Yvon. *Discriminative weighted alignment matrices for statistical machine translation*. in *Annual Conference of the European Association for Machine Translation*. 2011. Leuven, Belgium. 305-312.

C90.   Tomeh, N., M. Turchi, G. Wisniewski, A. Allauzen, and F. Yvon. *How Good Are Your Phrases? Assessing Phrase Quality with Single Class Classification*. in *International Workshop on Spoken Language Translation*. 2011. San Francisco, USA: Hwang, Mei-Yuh and Stüker, Sebastian. 8p.

C91.   Tran, V.A., V.B. Le, C. Barras, and L. Lamel. *Comparing Multi-Stage Approaches for Cross-Show Speaker Diarization*. in *Annual Conference of the International Speech Communication Association*. 2011. Florence, Italy. 1053--1056.

C92.   Vasilescu, I., S. Rosset, and M. Adda-Decker. *On the role of discourse markers in interactive spoken question answering systems*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 7p.

C93.   Vasilescu, I., S. Rosset, and M. Adda-Decker. *On the functions of the vocalic hesitation euh in interactive man-machine question answering dialogs in French*. in *Workshop on Disfluency in Spontaneous Speech - The 2nd International Symposium on Linguistic Patterns in Spontaneous Speech*. 2010. Tokyo, Japan. 4p.

C94.   Vasilescu, I., D. Yahia, N. Snoeren, M. Adda-Decker, and L. Lamel. *Cross-lingual study of ASR errors: on the role of the context in human perception of near-homophones*. in *Annual Conference of the International Speech Communication Association*. 2011. Florence, Italy. 4p.

C95.   Vaudable, C., N. Rollet, and L. Devillers. *Annotation of affective interaction in real-life dialogs collected in a call-center*. in *International Workshop on EMOTION : Corpora for Research on Emotion Affect*. 2010. Valetta, Malta. 5p.

C96.   Vergyri, D., L. Lamel, and J.-L. Gauvain. *Automatic speech recognition of multiple accented English data*. in *Annual Conference of the International Speech Communication Association*. 2010. Makuhari, Japan. 1652-1655.

C97.   Wisniewski, G., A. Allauzen, and F. Yvon. *Assessing phrase-based translation models with Oracle decoding*. in *Conference on Empirical Methods in Natural Language Processing*. 2010. Cambridge, USA. 933-943.

C98.   Wisniewski, G., A. Max, and F. Yvon. *Recueil et analyse d'un corpus écologique de corrections orthographiques extrait des révisions de Wikipédia*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2010. Montréal, Canada. 10p.

C99.   Zhang, Q.Q., L. Lamel, and J.-L. Gauvain. *Genre categorization and modeling for broadcast speech transcription*. in *Annual Conference of the International Speech Communication Association*. 2011. Florence, Italy. 4p.

C100.   Zidouni, A., S. Rosset, and H. Glotin. *Efficient combined approach for named entity recognition in spoken language*. in *Annual Conference of the International Speech Communication Association*. 2010. Makuhari, Japan. 1293-1296.

Conferences without proceedings, workshops

D1.   Adda, G. and J.-J. Mariani. *Language Resources and Amazon Mechanical Turk: ethical, legal, and other issues*. in *Workshop on Legal Issues for Sharing Language Resources (LISLR): Constraints and Best Practices in conjunction with LREC 2010*. 2010.

D2.   D'Alessandro, C., A. Quok, O. Deroo, D. Doukhan, R. Gelin, J.-C. Martin, C. Pelachaud, A. Rilliard, and S.

Rosset. *Towards a storytelling humanoid robot*. in *AAAI 2010 Fall Symposium on Dialog With Robots*. 2010.

D3.   Garcia-Fernandez, A., A.-L. Ligozat, M. Dinarelli, and D. Bernhard. *Méthodes pour l'archéologie linguistique : datation par combinaison d'indices temporels*. in *Atelier Défi Fouille de Textes*. 2011: TALN. 12p.

D4.   Grouin, C., A. Ben Abacha, D. Bernhard, B. Cartoni, L. Deléger, B. Grau, A.-L. Ligozat, A.-L. Minard, S. Rosset, and P. Zweigenbaum. *CARAMBA: Concept, Assertion, and Relation Annotation using machine-learning-based approaches*. in *Fourth i2b2/VA Shared-Task and Workshop Challenges in Natural Language Processing for Clinical Data*. 2010: i2b2/VA. 1.

D5.   Grouin, C., O. Galibert, S. Rosset, L. Quintard, and P. Zweigenbaum. *Mesures d'évaluation pour entités nommées structurées*. in *Ateliers joints QDC'2011 - EvalECD'2011. Évaluation des méthodes d'Extraction de Connaissances dans les Données*. 2011. 13p.

D6.   Mariani, J.-J. *Ethical Dimension of Crowdsourcing*. in *Annual Conference of the International Speech Communication Association*. 2011. Florence, Italy.

D7.   Mariani, J.-J. *Language Technologies in Support to Multilingualism*. in *International Symposium on Multilingualism in Cyberspace*. 2011. Brasilia, Brazil.

D8.   Mariani, J.-J. *Language resources, technologies and standards in the sharing paradigm*. in *International Joint Conference on Natural Language Processing*. 2011. Chiang Mai, Thailand.

D9.   Mariani, J.-J. *Charting the field to identify the gaps in META-VISION*. in *Language & Technology Conference : Human Language Technologies as a Challenge for Computer Science and Linguistics*. 2011. Poznan, Poland.

D10.   Mariani, J.-J., K. Choukri, and Z. Vetulani. *Getting less-resourced languages on-board!* in *Cocosda-Write-FLaReNet Workshop in conjunction with LREC 2010*. 2010.

CHRISTOPHE D'ALESSANDRO

Introduction

Research in the Audio & Acoustics (AA) Group is centered on audio and sound in human interaction and communication, studied along three main lines:

- Sound and space, including sound spatialisation and 3D audio, spatial hearing, virtual audio, and room acoustics,
- Expressive prosody, including production and perception of emotions, relationships with language and culture, similarities between vocal expression and music,
- Audio analysis and synthesis, including audio signal analysis, voice and speech synthesis, gestural control of synthesis, singing voice, organology and musical acoustics.

The domains of research of the AA group are closely tied to interests and works in other groups at LIMSI, in both the Human Machine Communication department and the Mechanics and Energetics Departments. There are a number of active collaborations with the TLP group (expressive prosody, prosody in dialectology), AMI group (sound interfaces), CPU group (sound in cognition and interaction), AERO group (voice source, cavity-flows), VENISE group (virtual acoustics), and VIDA action (sonic art and virtual materiality).

Research presentation

Topic 1: Sound & Space

B. Katz, *D. Schönstein, T. Bouchara, G. Parseihian, P. Luizard, L. Pointal, M. Rébillat, C. André (Univ. Liège), M. Aussal, D. Poirier-Quinot.*

Spatial hearing. Spatial hearing describes the ability to perceive sounds in three-dimensional space. For humans spatial hearing serves a variety of purposes, from pinpointing the location of a potential attacker to perceiving fullness and envelopment in a concert hall. One of the key factors in human spatial hearing which has become known over the past few decades is the Head-Related Transfer Function, or HRTF. Adaptation of a database of HRTF to specific individual is a key challenge for general public dissemination of spatial audio. Subjective classification of HRTF has been exploited in the thesis work of David Schönstein, towards an automated selection process based on morphological parameters extracted from photographs. This work presents a process which combines analysis of the subjective data, the measured HRTF database, and the associated morphological database using various data reduction techniques such as principal component analysis and frequency scaling in order to select the best match HRTF from the database for any given individual.

In this direction, an on-going study currently being explored in the context of the thesis of Gaëtan Parseihian aims at investigating the possibility for rapid auditory system adaptation in the full auditory sphere. We have employed an audio-kinesthetic Virtual Auditory Environment (VAE) platform which allows for the association of the physical position of a virtual sound source with an alternate set of acoustic spectral cues through the use of a tracked physical ball manipulated by the subject. This set-up offers a natural perception-action coupling which is not limited to the visual field of view. Results (cf. fig 1) show how subjects with good individually matched HRTFs exhibited steady improvement relative to the control group and subjects with bad individually matched HRTFs.

Room acoustics. Work in this area can be divided into four categories: measurement, design, auralization, and perception. Recent work includes the use of acoustical scale model techniques on existing historical models and is seen as a means of increasing our understanding of constructions either no longer existing, or only conceived of by architects. Scale models have an important place in architectural acoustics as they can be used to address issues which are traditionally problematic for numerical computations. In recent years the application of scale model studies has been extended to address the fundamental issues relating to coupled volume acoustics, the central theme of the thesis recently begun by Paul Luizard. While coupled volumes have been present as a design element in a number of performing arts venues over the past decades, the physical behaviour of such architectural spaces is rather poorly understood, leading to design and performance issues in such installations. The field of variable acoustics and coupled volume

reverberation chambers is a growing field. One aspect being addressed has been the use of scale models to improve and redefine room acoustic parameter estimations in the context of coupled volumes. Precise analysis of sound energy decay in coupled volumes is necessary and standardization of such analysis methods still does do not clearly exist for non-linear sound energy decays. An accurate analysis method should be robust in order to identify the real characteristics, despite the fluctuations of decay curves. We have developed a "new marching" line method for estimating non-linear decay characteristics. This method addresses several issues with existing, standardized methods such as the Schroeder backward integration curve, in the case of coupled volume non-linear decays.

Virtual Reality and Audio Interfaces. The third research direction of the theme is that of spatial audio rendering and its application to virtual reality or other interfaces. This area is in general more applied, and can be divided into: studies concerning the development of spatial audio rendering techniques, applied use of spatial audio in multi-modal interfaces, and specific projects which are concerned with the use of spatial audio for research with the blind.

In collaboration with the industrial partner Sonic Emotion, Switzerland, we developed a system which provides high spatial audio precision without the limitations of previous systems concerning image projection. The system, labelled SMART-I² (cf. fig 1), for "Spatial Multi-user Audio-visual Real-Time Interactive Interface", aims at creating a precise and coherent virtual environment by providing users with both auditorily and visually accurate localization cues.
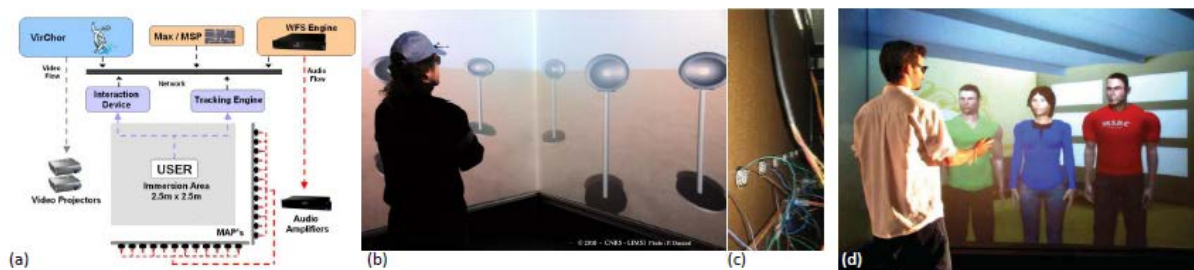
Figure 1 - SMART-I² (a) architecture, (b) view from the user perspective, and (c) rear view of actuators. (d) Virtual characters of the MARC platform for real-time affective interaction integrated into SMART-I².

A specific task under consideration in the thesis of Tifanie Bouchara is that of video browsing, where a user must select among a large number of available videos. We have focused on the advantage of access to multi-modal information within audio-visual databases, and the evaluation of the effect of combining the visual modality with audio information. Two new exploration tools were developed which extend two traditional information visualization techniques, Fisheye Lens and Pan&Zoom, to the auditory modality. The fisheye lens technique combined coherent distortion of graphics, sound source spatialization, and sound volume level. To improve audio source segregation, the zone within the fisheye lens was re-centred and superposed over the elements outside the lens, creating a type of bifocal transparency metaphor for the audio condition. The pan&zoom technique was designed without visual distortion but with low audio volume distortion.

The project NAVIG (Navigation Assisted by artificial VIsion and GNSS) has as its overriding goal the development of a navigational aid for the visually impaired which will increase the autonomy of its users in known and unknown environments, exterior and interior, large scale and small scale. The approach employs a combination of a Global Navigation Satellite System (GNSS) and rapid visual recognition with which the precise position of the user can be determined. Relying on geographical databases and visually identified objects, the user is guided to their desired destination through spatialized audio rendering, always maintained in the head-centred reference frame. Our main effort in the project, the context of the thesis of Gaëtan Parseihian, concerns the development of sonification strategies related to informative guidance.

Topic 2: Expressive prosody

A. Rilliard, C. d'Alessandro, I. Lehka, A. Pavard, L. Pointal, D. Doukhan

Cross-cultural prosodic social affects. Languages and cultures develop specific and prototypic strategies to express the point of view of the speaker on their own discourse (propositional attitudes such as doubt, irony), as well as to manage the relationship with their interlocutor (social attitudes such as (im)politeness, seduction). Such strategies are based on the use of specific lexical and syntactic elements, kinetic behaviour, and prosodic variations. This expressive lexicon is specific to each language and culture in

its inventory and in the precise pragmatic use of each attitude. Corpora of such audio-visual expressions have been recorded in French, Japanese, and Brazilian Portuguese and are used in cross-cultural perception tests designed to measure the specificity of each attitude in the different modalities of presentation (audio, visual, conceptual). Such attitudes are also progressively acquired by native children during infancy, as shown by perception test on children of growing age for (im)polite prosodic expressions in Japanese.

Prosodic variation across dialects. At another level of prosodic description, the accentual and phrasal segmentation prosodic strategies also vary across dialects. The AMPER (for Romance Area Multimedia Prosodic Atlas) project aims at measuring this variability among the romance languages. Objective and subjective measurements are carried out to measure this variability and its impact on the image of a given dialect. Works on automated metrics for *geoprosodic* representations have already given a first mapping of European Portuguese dialectal variations (cf. fig. 2). Current works investigate a possible prosodic transfer from Corsican to Corsican French, and its implications on the representation of the Corsican accent in France.
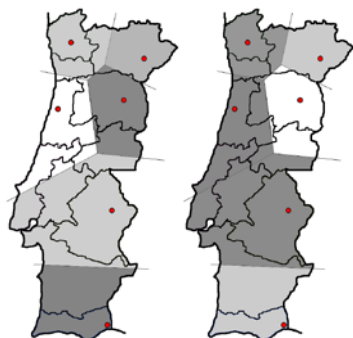
Figure 2 – Examples of dialectometric maps of European Portuguese prosodic variations obtain from 6 dialectal inquiries. Grey scale represents the prosodic distance measured between the white area and another investigation point.

Observed distances confirm the results of a previous perception test measuring the perceived distances between these dialects.

Objective measures of prosodic distances. For each of the different functions performed by prosody, specific and coherent variations can be observed and are related to a specific meaning. For example, dedicated intonation contours have been observed for attitudes, for Corsican vs. French interrogatives, etc. Such prototypical variations of prosodic parameters across time are constrained by the linguistic structure of sentences. A Dynamic Time Warping scheme has been set up to time-align the measured contour non-linearly, in order to obtain comparable contours and to measure objective distances for different sets of prosodic functions.

Topic 3: Audio Analysis and synthesis

C. d'Alessandro, N. Delprat, D. Sciamarella, L. Pointal, N. Sturmel, S. LeBeux, L. Feugère, D. Cadic (Orange Labs), M. Evrard, N. Audibert. S.Z. Karakozoglou

Expressive Text-to-Speech Synthesis. Three projects involving expressive text-to-speech (TTS) synthesis have been recently conducted. The GV-LEX project aims at giving storytelling ability to the NAO humanoid robot. One main point is to improve text-to-speech synthesis expressivity according to a semi-automatic analysis of a given tale. Automatic tagging and prosodic stylization was applied to the corpus. The extracted parameters are described and analysed according to relevant elements of the tales structure. The results underline the expressive strategy used by the speaker to impersonate the different kinds of characters and during the different structural parts of each tale. This prosodic analysis is used to enhance the expressivity of the Acapela non-uniform-units text-to-speech synthesizer. The second project, in collaboration with Orange Labs, concerned text corpus development for high quality TTS synthesis. The main question was to design the smallest possible text corpus for the best possible speech quality. A database of 16 different styles for a single speaker has been analysed in terms of prosody and voice source quality. The third project, which started recently, aims at designing a personalized TTS system, able to mimic a given character in video games or cinema. The SELIMSI TTS engine developed some years ago will serve as a basis for this project.

Gestural control of synthesis is prosody and singing voice. Gestural control of speech synthesis is a new approach to expressive speech and voice synthesis developed at LIMSI over the past few years. Our work concerned mainly two fields: formal evaluation of the analogy between hand gestures and expressive prosody in speech, and gesture-controlled voice synthesisers for musical applications. Intonation stylization was studied in the present research, using "chironomy" (coming from the Greek "*cheir*" meaning "hand" and "*nomos*" meaning "rule"), i.e., the analogy between hand gestures and prosodic movements. The aim was to explore our ability to control and copy speech prosody with the help of hand gestures. An intonation-mimicking paradigm was used. The task of the ten subjects was to copy the intonation pattern of

sentences with the help of a stylus on a graphic tablet, using a system for real-time manual intonation modification. Gestural imitation was compared to vocal imitation of the same sentences. Distance measures between gestural copies, vocal imitations, and original sentences were computed for performance assessment. Perceptual testing was also used for assessing the quality of gestural copies. The results indicated that chironomic stylization is effective, and that hand movements can be analogous to intonation movements. Real-time gestural control of voice synthesis was also studied and used for musical purposes. The ability of using handwriting gestures for controlling singing intonation (chironomic singing synthesis) was studied. The "Chorus Digitalis", a choir of synthetic singing synthesizers was developed. Performances of subjects using the system were analysed. The results showed that chironomic "singers" were able to control melody with accuracy, perform vibrato, portamento, and other types of fine-grained intonation variations, and gave convincing musical performances.

Figure 3 Wavelet analysis and high speed video imaging of the glottal vibration.
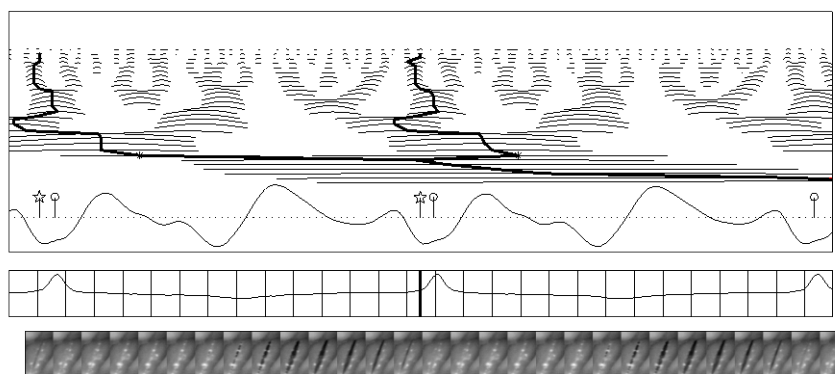
Voice source and signal analysis. Signal processing methods for analysis of expressive speech are developed. We are developing toolboxes for analysing voice source parameters, using methods like the ZZT, Lines of Maximum Amplitude of the Wavelet transform (see an example of analysis in Figure 3), or periodic-aperiodic decompositions. Voice source analysis has been applied to large corpora of expressive speech, for the synthesis of children tales or expressive TTS. These works are continuing in the new AND-TR project, aiming at characterizing the expressive space of a given speaker for video game or cinema applications. Image processing has also been used for voice source analysis, and a new method for visualisation of the motion of vocal folds has been studied (glottovibrography) in the framework of an ERASMUS project with Greece. D. Sciamarella, in the framework of the STIC-AMsud program "modelling voice production", worked on the functioning of vocal folds and ventricular bands using models and numerical simulations. In collaboration with the AERO group, N. Delprat has investigated the coupling between non-linear interactions and modulation mechanisms in cavity-flows through a modulation analysis approach, initially developed in the domain of audio computing. The modulated character of various incompressible cavity-air flows has been investigated. Diverse amplitude modulation regimes have been pointed out and their possible role in mode competition mechanisms has been studied with the help of time-frequency analyses at different locations in the cavity.

Musical acoustics and organology. Works in musical acoustics and organology concerned keyboard instruments, like the clavichord, piano and pipe organ. The acoustics of the most expressive keyboard instrument, the clavichord, and particularly its dynamics was studied. A comparative study of the acoustics of the clavichord and pianoforte was conducted. Audio-visual digital augmentation of the pipe organ, a project initiated some years ago, continued to foster interest. N. Delprat has initiated an interdisciplinary project (CLOUD) devoted to the virtual experience of an evanescent matter through a cloud-avatar. This research addresses several issues related to the correlation of audio and visual dimensions in virtual embodied representations.

Highlights

- **Chironomic stylization of intonation**. We demonstrate that the melodic movements of speech (intonation) may be reproduced as accurately by voice than by manual gesture (chironomy). This required the development of an original interface (Calliphony system), for

real-time gestural control of voice synthesis. The analogy between intonation and gesture opens new avenues for prosodic models. Following this work, an orchestra of gesture-controlled voice synthesizer, the "chorus digitalis" has been developed.

- **Study of perceived distance: audio, visual, & audiovisual**. A new platform, SMART-I², allows the study of multimodal perception of audio, visual, and audio-visual distance. This required the study of vibratory plates, for the restitution of spatial sound with shakers on rigid projection screens video.
- **Digital augmentation of the pipe organ**. C. d'Alessandro has been invited to install and play an augmented organ for the opening concert of the European Heritage Days 2010 by the city of Lille, and for the festival "Le Paris des Orgues", 2011. This work was also invited in the distinguished lecture series at CIRMMT, McGill University.

Staff

Permanent Staff

Firstname	Lastname	Type of position	Employer	HDR	Arrival date	Departure date
Christophe	d'Alessandro	DR	CNRS	HDR		
Nathalie	Delprat	Ass. Prof.	UPMC			
Brian	Katz	CR	CNRS	HDR		
Laurent	Pointal	Res. Eng.	CNRS			
Albert	Rilliard	CR	CNRS			
Denisse	Sciamarella	CR	CNRS			

PhD Students

Firstname	Lastname	Graduate school	University	Type of support	Start date	Date of defense
Matthieu	Aussal	Polytechnique	Polytechnique	CIFRE/CDD DMS	01/10/2011	
Tifanie	Bouchara	EDIPS	U-PSud	MNRT PhD grant	01/10/2008	
David	Doukhan	EDIPS	U-PSud	CDD CNRS ANR GV-LEX	01/10/2009	
Marc	Evrard	EDIPS	U-PSud	CDD CNRS ADN.T.R	01/01/2012	
Lionel	Feugère	SMAER	UPMC	CDD CNRS ANR ORJO	01/12/2009	
Paul	Luizard	SMAER	UPMC	UPMC PhD grant	01/10/2010	
Gaëtan	Parseihian	SMAER	UPMC	CDD.CNRS ANR NAVIG	03/11/2008	
David	Poirier-Quinot	SMAER	UPMC	CIFRE/CDD ASTRIUM	15/10/2011	
Marc	Rebillat	Polytechnique	Polytechnique	MNRT PhD grant	01/09/2008	17/11/2011
David	Schonstein	SMAER	UPMC	Cifre/CDD ARKAMYS	02/04/2007	
Nicolas	Sturmel	STITS	U-PSud	ENS PhD grant	01/12/2006	02/03/2011

Non permanent staff

Firstname	Lastname	Type of position	Employer	Arrival date	Departure date
Sylvain	Le Beux	Post-Doc	CNRS	01/09/2010	31/10/2011

Indicators of scientific notoriety

Editorial board appointment

- C. d'Alessandro is an Associate Editor of the EURASIP Journal on Speech Audio and Music Processing, and a member of the editorial board of the Journal of Speech Sciences.
- A. Rilliard is a member of the editorial board of the Journal of Speech Sciences.

Organization of international or national scientific events

Member of the scientific, technical program and/or organizational committees for international/national conferences or workshops

- C. d'Alessandro has been member of the Local Scientific Committee of the 14th International Conference on Digital Audio Effects, DAFx-11, and member of the scientific review committees of many international conferences, including: Interspeech 2010, 2011, PEVOC9, Icassp 2010, 2011, 2012, JIM 2012, ICPhS 2011, P3S 2011.
- B. Katz was in the organizing committee of The 2nd International Symposium on Ambisonics and Spherical Acoustics, Paris, France (2010)

Invited lectures, talks or seminars

Invited workshop speaker

- C. d'Alessandro « Computerized Chironomy : Five Years of Gesture-Controlled Voice and Speech Synthesis at LIMSI, 1st International Workshop on Performative Speech and Singing Synthesis (p3s), Vancouver, 14-15 mars 2011.

Tutorial at workshops or conferences or summer schools

- C. d'Alessandro "La parole comme mouvement: glossolalies chironomiques" XXVIIIèmes Journées d'Étude sur la Parole JEP 2010 - 25-28 mai 2010, Mons, Belgique.
- C. d'Alessandro has been a distinguished lecturer at McGill Université (Montreal, Canada), CIRMMT (Center for Interdisciplinary Reaserch in Music Media and Technology, 2012).

Invited talk (national or international)

- C. d'Alessandro « Révolution (industrielle) dans la facture instrumentale », université de printemps, Festival de l'histoire de l'art, Institut National d'Histoire de l'Art, Fontainebleau, 27-28 mai 2011.

Participation in expertise and administration of research

International or national scientific networking

International networks

- A. Rilliard is a member of the AMPER project (projet d'Atlas Multimedia Prosodique de l'Espace Roman) – grouping researchers from more than 10 countries and 30 universities across romance speaking countries across Europe and Latin America.
- C. d'Alessandro is member of the scientific committee of the Enterface workshops network.

National networks or working groups

- B. Katz is a member of the Musical Acoustic Committee of the Société Française d'Acoustique

Participation in evaluation or expertise committees

International:

- C. d'Alessandro has been reviewer for the cooperation program ECOS–MINCyT, Argentina and Chili (2011), for the Austrian Science Fund (FWF), 2012.
- B. Katz is a reviewer for the Austrian Science Fund (FWF).

National committees (CoNRS, CNU, CCSU…)

- C. d'Alessandro is member of the CCSU in computer science, University Paris Sud.
- C. d'Alessandro has been expert for the program "Research in Paris", for foreign researchers in Paris.
- A. Rilliard is member of the CCSU in computer science, Université Paris Sud.

Expert for scientific evaluation committees

- C. d'Alessandro participated to the AERES scientific evaluation committees of GIPSA-LAB (Grenoble, 2010), IRCAM (Paris, 2010) and ACROE (Grenoble 2010).
- C. d'Alessandro is a reviewer for the ANR.
- B. Katz is a reviewer for the ANR.

- B. Katz is a reviewer for the government industrial tax incentive program "Crédit d'Impôt Recherche".

Member of the administration or advisory board

- C. d'Alessandro is a member of the Commission Supérieure des Monuments Historiques (organs and musical instruments), Ministry of Culture.

Member of selection juries

- C. d'Alessandro participated to selection committees in electrical engineering at UPMC (Paris 6).

Teaching activities and duties in relation to research

- B. Katz taught the audio virtual reality in the computer science master, university Paris Sud.
- N. Delprat taught the musical sound analysis in the Licence of physics, UPMC, Paris 6.

Dissemination and vulgarization

- N. Delprat presented her work in the « Nuit des chercheurs de l'X », 23 sept. 2011, Ecole Polytechnique-Palaiseau, and in the « Fête de la Science en Ile de France », 13 oct. 2011, Créteil
- G Parseihian and B. Katz participated in the "Fête de la Science en île-de-France", 22-24 oct. 2010, Orsay.
- C. d'Alessandro participated in the science related television series E=M6 (M6 TV Chanel) twice in 2011.

Research conventions and contracts

Valorization

- Patent : Katz, B.F.G. and Schönstein, D., « Method for selecting perceptually optimal HRTF filters in a database according to morphological parameters », French Patent N° WO/2011/128,583, 20/10/2011
- Protected software: Hammerstein Toolbox, by M. Rébillat / R. Hennequin / A. Novak 30 Mar 2011 (Updated 08 Feb 2012, Matlab Toolbox)

Industrial relationships

- CIFRE conventions with Arkamys CIFRE (2007-2010), Digital Media Solutions, (2011-2014), Astrium, (2012-2015)
- Collaboration with Sonic Emotion, Aldebaran Robotics, Orange Labs, Puce-Muse, ADN, Vocally. Acapela, Digital Media Solutions.

Contract table

Acronym	Funding agency/Partner	Program	Nature	Resp. for LIMSI	General coordinator	Starting date	Ending date	LIMSI share
	Arkamys	CIFRE	PhD supervision	Katz B.	Katz B.	02/04/2007	01/04/2010	44251
Prototype d'écran haut-parleur	Sonic Emotion		Research collab.	Katz B.	Katz B.	03/03/2008	02/03/2010	
GV-Lex	ANR	CONTINT	Research collab.	d'Alessandro Ch.	Gelin R. (CEA)	15/12/2008	14/06/2012	202807
NAVIG	ANR	TecSan	Research collab.	Katz B.	Jouffrais Ch. (IRIT)	01/01/2009	31/10/2012	263802
Technologies acoustiques	Sonic Emotion		Non-disclosure agreem.	Katz B.	Katz B.	01/02/2009	31/01/2014	
	France Télécom		Research collab.	d'Alessandro Ch.	d'Alessandro Ch.	01/10/2009	30/09/2010	31740
OrJo	Région Ile de France	FEDER	Research collab.	d'Alessandro Ch.	De Laubier S. (PUCE-MUSE)	01/12/2009	30/11/2012	128000
prêt LSE	Arkamys		Non-disclosure agreem.	Katz B.	Katz B.	12/01/2010	11/07/2010	
Orgue et Réalité Augmentée	Ville de Lille		Contract of services	d'Alessandro Ch.	d'Alessandro Ch.	01/06/2010	30/09/2010	7525

PADE	ANR	JCJC	Research collab.	Rilliard A.	Rilliard A.	15/12/2010	30/11/2014	163512
	DMS	CIFRE	PhD supervision	Katz B.	Katz B.	24/01/2011	23/01/2015	15000
AND-TR	Région Ile de France	Competitiveness cluster	Research collab.	Martin JC/ d'Alessandro C.	Guiard C. (ADN)	01/12/2011	30/11/2014	531140

Scientific publications

Doctoral theses and HDR

T1. Cadic, D., *Développement rapide de voix de synthèse, algorithmes et évaluation* 2011, thèse de l'Université Paris-Sud. Soutenue à Orange Labs R&D, Lannion, le 10 juin 2011, 187 p.

T2. Katz, B., *« Son & Espace » : Contributions to research concerning sound in space*, 2011, HDR de l'Université Pierre et Marie Curie, soutenue au LIMSI, Orsay, le 18 novembre 2011. 220 p.

T3. Rebillat, M., Vibrations de plaques multi-excitateurs de grandes dimensions pour la création d'environnements virtuels audio-visuels: approches acoustique, mécanique et perceptive 2011, thèse de l'École Polytechnique. Soutenue à l'Ecole Polytechnique, Palaiseau, le 17 novembre 2011, 274 p.

T4. Sturmel, N., *Analyse de la qualité vocale appliquée à la parole expressive* 2011, thèse de l'Université Paris-Sud. Soutenue au LIMSI, Orsay, le 2 mars 2011, 230 p.

Articles in peer reviewed scientific journals

A1. Afonso, A., A. Blum, B. Katz, P. Tarroux, G. Borst, and M. Denis, *Structural properties of spatial representations in blind people : scanning images constructed from haptic exploration or from locomotion in a 3-D audio virtual environment.* Memory & Cognition, 2010. **38**: pp.591-604.

A2. Audibert, N., V. Auberge, and A. Rilliard, *Discrimination perceptive d'expressions émotionnelles actées vs. spontanées. Variabilité interindividuelle et influence de l'intensité de l'émotion.* Technique et Science Informatiques, numéro spécial sur les Agents Conversationnels Animés, 2010. **29** (7): pp.833-857.

A3. Basley, J., L. Pastur, F. Lusseyran, T. Faure, and N. Delprat, *Experimental investigation of global modes in an incompressible cavity flow using time-resolved PIV.* Experiments in Fluids, 2011. **50** (4): pp.905-918.

A4. Boula De Mareüil, P., A. Rilliard, and A. Allauzen, *A diachronic study of initial stress and other prosodic features in the French news announcer style: corpus-based measurements and perceptual experiments.* Language and Speech, 2011. pp.1-31.

A5. Chisari, N., G. Artana, and D. Sciamarella, *Vortex dipolar structures in a rigid model of the larynx at flow onset.* Experiments in Fluids, 2011. **50**: pp.397-406.

A6. D'Alessandro, C., *On the dynamics of the clavichord: from tangent motion to sound.* Journal of the Acoustical Society of America, 2010. **128** (4): pp.2173-2181.

A7. D'Alessandro, C., A. Rilliard, and S. Le Beux, *Chironomic stylization of intonation.* Journal of the Acoustical Society of America, 2011. **129** (3): pp.1594-1604.

A8. D'Alessandro, C. and N. Sturmel, *Glottal closure instant and voice source analysis using time-scale lines of maximum amplitude.* Sadhana - Academy Proceedings in Engineering Sciences, 2011. **36** (5): pp.601-622.

A9. De Castro Moutinho, L., R. Coimbra, A. Rilliard, and A. Romano, *Mesure de la variation prosodique diatopique en portugais européen.* Estudios de Fonética Experimental, 2011. **XX**: pp.35-55.

A10. Delprat, N., *Low-frequency components and modulation processes in compressible cavity flows.* Journal of Sound and Vibration, 2010. **329** (22): pp.4797-4809.

A11. Delprat, N., C. Leroux, and S. Fdili Alaoui, *Experience of a cloud-avatar: Scientific challenges and artistic perspectives.* International Journal of Design and Innovation Research (IJODIR), 2011. **6** (1): pp.127-143.

A12. Jacquemin, C., R. Ajaj, S. Le Beux, C. D'Alessandro, M. Noisternig, B. Katz, and B. Planes, *Organ augmented reality: audio-graphical augmentation of a classical instrument.* International Journal of Creative Interfaces and Computer Graphics, 2010. **1** (2): pp.51-66.

A13. Katz, B., O. Delarozière, and P. Luizard, *A ceiling case study, inspired by an historical scale model.* Acoustics Bulletin, 2011. **36** (6): pp.38-43.

A14. Krebs, F., F. Silva, D. Sciamarella, and G. Artana, *A Three-dimensional study of the glottal jet.* Experiments in Fluids, 2011. pp.1-15.

A15. Patynen, J., B. Katz, and T. Lokki, *Investigations on the balloon as an impulse source.* Journal of the Acoustical Society of America, 2011. **129** (1): pp.EL27-EL33.

A16.   Rebillat, M. and X. Boutillon, *Measurement of relevant elastic and damping material properties in sandwich thick plates.* Journal of Sound and Vibration, 2011. **330** (25): pp.6098-6121.

A17.   Rebillat, M., R. Hennequin, E. Corteel, and B. Katz, *Identification of cascade of Hammerstein models for the description of non-linearities in vibrating devices.* Journal of Sound and Vibration, 2011. **330** (5): pp.1018-1038.

A18.   Romano, A., M. Contini, J. Lai, and A. Rilliard, *Distancias prosódicas entre variedades románicas en el marco del proyecto AMPER.* Revista Internacional de Lingüística Iberoamericana, 2011. **IX** (1): pp.13-25.

Books & chapters in books

B1.   D'Alessandro, C., *Orgues, musiques et musiciens à Sainte-Élisabeth*. Vol. 91. 2011: Association Aristide cavaillé-Coll. 224p.

B2.   D'Alessandro, C., *The acoustics of tangent-string interaction in the clavichord compared to hammer-string interaction in the fortepiano*, in *De Clavicordio, XI*, B. Brauchli, A. Galazzo, and J.E. Wardman, Eds. 2011, Musica Antica à Magnano. pp. 83-90.

B3.   Frissen, I., B. Katz, and C. Guastavino, *Effect of sound source stimuli on the perception of reverberation in large volumes*, in *Auditory display, LNCS 5954,* 2010, Springer. pp. 358-376.

B4.   Katz, B. and L. Picinali, *Spatial audio applied to research with the Blind*, in *Advances in Sound Localization*, P. Strumillo, Editor. 2011, InTech. pp. 225-250.

B5.   Noisternig, M., F. Zotter, and B. Katz, *Reconstructing sound source directivity in virtual acoustic environments*, in *Principles and applications of spatial hearing*, Y. Suzuki, et al., Eds. 2011, World Scientific Publishing Company. pp. 357-372.

B6.   Okamoto, T., B. Katz, M. Noisternig, Y. Iwaya, and Y. Suzuki, *Implementation of real-time room auralization using a surrounding 157 loudspeaker array*, in *Principles and applications of spatial hearing*, Y. Suzuki, et al., Eds. 2011, World Scientific Publishing Company. pp. 373-382.

Conferences with proceedings and review committee

C1.   Ammi, M. and B. Katz. *Design of haptic stimuli for audio-haptic concurrent coupling*. in *IEEE International Symposium on Haptic Audio-Visual Environments and Games*. 2011. Hebei, China. 74-80.

C2.   Audibert, N., V. Auberge, and A. Rilliard. *Prosodic correlates for the discrimination of acted vs spontaneous expressive speech : a pilot study*. in *International Conference on Speech Prosody*. 2010. Chicago, USA. 4p.

C3.   Bouchara, T., B. Giordano, I. Frissen, B. Katz, and C. Guastavino. *Effect of signal-to-noise ratio and visual context on environmental sound identification*. in *Convention of the Audio Engineering Society*. 2010. London, UK. 11p.

C4.   Bouchara, T., B. Katz, C. Jacquemin, and C. Guastavino. *Audio-visual renderings for multimedia navigation*. in *International Conference on Auditory Display*. 2010. Washington, D.C., USA. 245-252.

C5.   Cabrera, D., T. Okamoto, B. Katz, M. Noisternig, Y. Iwaya, and Y. Suzuki. *Considerations in characterising an almost anechoic room for interactive spatial audio reproduction*. in *International Symposium on Room Acoustics*. 2010. Melbourne, Australia. 6p.

C6.   Cadic, D., C. Boidin, and C. D'Alessandro. *Towards optimal TTS corpora*. in *International Conference on Language Resources and Evaluation*. 2010. Valetta, Malta. 6p.

C7.   Cadic, D. and C. D'Alessandro. *High quality TTS voices within one day*. in *ISCA Speech Synthesis Workshop*. 2010. Kyoto, Japan. 288-293.

C8.   Caramiaux, B., S. Fdili Alaoui, T. Bouchara, G. Parseihian, and M. Rebillat. *Gestural auditory and visual interactive platform*. in *International Conference on Digital Audio Effects*. 2011. Paris, France. 4p.

C9.   D'Alessandro, C., S. Le Beux, and A. Rilliard. *Contrôle gestuel du modèle source / filtre de production de la voix*. in *Congrès Français d'Acoustique*. 2010. Lyon, France. 4p.

C10.   De Moraes, J., A. Rilliard, B. Alberto, and T. Shochi. *Multimodal perception and production of attitudinal meaning in Brazilian Portuguese*. in *International Conference on Speech Prosody*. 2010. Chicago, USA. 4p.

C11.   Delprat, N., C. Leroux, and S. Fdili Alaoui. *In the clouds - Virtual experience of a matter*. in *Virtual Reality International Conference*. 2011. Laval, France. 5p.

C12.   Doukhan, D., A. Rilliard, S. Rosset, M. Adda-Decker, and C. D'Alessandro. *Prosodic analysis of a corpus of tales*. in *Annual Conference of the International Speech Communication Association*. 2011. Firenze, Italy: ISCA - ISSN 1990-9772. 3129-3132.

C13.   Evrard, M., C. André, J. Verly, J.-J. Embrechts, and B. Katz. *Object-based sound re-mix for spatially coherent audio rendering of an existing stereoscopic-3-D animation movie*. in *Convention of the Audio Engineering Society*. 2011. New York, USA. 8486_1-8486_15.

C14. Feugère, L., S. Le Beux, and C. D'Alessandro. *Chorus digitalis : polyphonic gestural singing*. in *International Workshop on Performative Speech and Singing Synthesis*. 2011. Vancouver (Canada): University of British Columbia. 4p.

C15. Katz, B., O. Delarozière, and P. Luizard. *A ceiling case study inspired by an historical scale model*. in *International Conference on Auditorium Acoustics*. 2011. Dublin, Ireland. 314-321.

C16. Katz, B. and L. Picinali. *Exploration of virtual acoustic room simulations by the visually impaired*. in *International Seminar on Virtual Acoustics*. 2011. Valencia, Spain. 169-177.

C17. Katz, B., P. Truillet, S. Thorpe, and C. Jouffrais. *NAVIG: navigation assisted by artificial vision and GNSS*. in *Workshop on Multimodal Location Based Techniques for Extreme Navigation*. 2010. Helsinki, Finland. 4p.

C18. Krebs, F., G. Artana, and D. Sciamarella. *Glottal aperture modes and acoustic output in an in-vitro self-oscillating vocal-fold model*. in *Congrès Français d'Acoustique*. 2010. Lyon, France. 1-4.

C19. Le Beux, S., C. D'Alessandro, and A. Rilliard. *Calliphony : a tool for real-time gestural modification and analysis of intonation and rythm*. in *International Conference on Speech Prosody*. 2010. Chicago, USA. 4p.

C20. Le Beux, S., B. Doval, and C. D'Alessandro. *Issues and solutions related to real-time TD-PSOLA implementation*. in *Convention of the Audio Engineering Society*. 2010. London, UK. 6p.

C21. Le Beux, S., L. Feugère, and C. D'Alessandro. *Chorus digitalis : experiment in chironomic choir singing*. in *Annual Conference of the International Speech Communication Association*. 2011. Firenze, Italy: ISCA. 2005-2008.

C22. Luizard, P. and B. Katz. *Coupled volume multi-slope room impulse responses: a quantitative analysis method*. in *International Conference on Auditorium Acoustics*. 2011. Dublin, Ireland. 169-176.

C23. Mac, D., V. Auberge, A. Rilliard, and E. Castelli. *Perception interculturelle des attitudes audio-visuelles vietnamiennes*. in *Journées d'Etude sur la Parole*. 2010. Mons, Belgique. 4p.

C24. Mac, D., V. Auberge, A. Rilliard, and E. Castelli. *Cross-cultural perception of Vietnamese audio-visual prosodic attitudes*. in *International Conference on Speech Prosody*. 2010. Chicago, USA. 4p.

C25. Mariette, N., B. Katz, K. Boussetta, and O. Guillerminet. *Sounddelta : a study of audio augmented reality using wifi-distributed ambisonic cell rendering*. in *Convention of the Audio Engineering Society*. 2010. London, UK. 15p.

C26. Menelas, B., L. Picinali, B. Katz, and P. Bourdot. *Audio haptic feedbacks in a task of targets acquisition*. in *IEEE Symposium on 3D User Interfaces*. 2010. Waltham, USA. 51-54.

C27. Okamoto, T., D. Cabrera, M. Noisternig, B. Katz, Y. Iwaya, and Y. Suzuki. *Improving sound field reproduction in a small room based on higher-order ambisonics with a 157-loudspeaker array*. in *International Symposium on Ambisonics and Spherical Acoustics*. 2010. Paris, France. 4p.

C28. Picinali, L., B. Katz, A. Afonso, and M. Denis. *Acquisition of spatial knowledge of architectural spaces via active and passive aural explorations by the blind*. in *Forum Acusticum*. 2011. Aalborg, Denmark. 1311-1316.

C29. Picinali, L., B. Menelas, B. Katz, and P. Bourdot. *Evaluation of a haptic / audio system for 3-D targeting tasks*. in *Convention of the Audio Engineering Society*. 2010. London, UK. 11p.

C30. Rebillat, M. and X. Boutillon. *Identification of elastic and damping properties of sandwich structures based on high resolution modal analysis of point measurements*. in *International Conference on Noise and Vibration Engineering*. 2010. Leuven, Belgium. 2577-2589.

C31. Rebillat, M. and X. Boutillon. *Identification of honeycomb sandwich properties by high-resolution modal analysis*. in *International Conference on Experimental Mechanics*. 2010. Poitiers, France. 8p.

C32. Rebillat, M. and X. Boutillon. *A method to measure elastic and dissipative material properties of sandwich structures and its numerical validation*. in *Colloque National en Calcul des Structures*. 2011. Giens, France. 8p.

C33. Rebillat, M., X. Boutillon, E. Corteel, and B. Katz. *Audio, visual, and audio-visual egocentric distance perception in virtual environments*. in *Forum Acusticum*. 2011. Aalborg, Denmark. 1287-1292.

C34. Rebillat, M., R. Hennequin, E. Corteel, and B. Katz. *Prediction of harmonic distortion generated by electro-dynamic loudspeakers using cascade of Hammerstein models*. in *Convention of the Audio Engineering Society*. 2010. London, UK. 10p.

C35. Rilliard, A., A. Allauzen, and P. Boula De Mareüil. *Using dynamic time warping to compute prosodic similarity measures*. in *Annual Conference of the International Speech Communication Association*. 2011. Florence, Italy. 2021-2024.

C36. Schonstein, D. and B. Katz. *Sélection de HRTF dans une base de données en utilisant des paramètres morphologiques pour la synthèse binaurale*. in *Congrès Français d'Acoustique*. 2010. Lyon, France. 7p.

C37. Schonstein, D. and B. Katz. *Variability in perceptual evaluation of HRTFs*. in *Convention of the Audio Engineering Society*. 2010. London, UK. 11p.

C38. Schonstein, D. and B. Katz. *HRTF selection for binaural synthesis from a database using morphological parameters*. in *International Congress on Acoustics*. 2010. Sidney, Australia. 6p.

C39. Sciamarella, D., F. Krebs, and G. Artana. *Tracking vortex dipolar structures in a laryngeal-like jet*. in *Argentinian Congress on Computational Mechanics*. 2010. Buenos Aires, Argentina: Asociacion Argentina de Mecánica Computacional. 3883-3889.

C40. Shochi, T., G. Gagnié, A. Rilliard, D. Erickson, and V. Auberge. *Learning effect of French prosodic social affects for Japanese learners of French language*. in *International Conference on Speech Prosody*. 2010. Chicago, USA. 4p.

C41. Sturmel, N., C. D'Alessandro, and B. Doval. *Glottal parameters estimation on speech using the Zero of the Z-transform*. in *Annual Conference of the International Speech Communication Association*. 2010. Makuhari, Japan. 665-668.

Conferences without proceedings, workshops

D1. Alizard, F., J. Basley, J. Robinet, T. Faure, L. Pastur, X. Gloerfelt, F. Lusseyran, and N. Delprat. *Flow dynamics in open square cavity : experimental and stability comparisons*. in *European Fluid Mechanics Conference*. 2010. Bad Reichenhall, Germany: Euromech.

D2. Caramiaux, B., S. Fdili Alaoui, T. Bouchara, G. Parseihian, and M. Rebillat. *Gestural auditory and visual interactive platform*. in *Versatile Sound Models for Interaction in Audio-Graphic Virtual Environments: Control of Audio-graphic Sound Synthesis Workshop*. 2011: IRCAM. 1.

D3. Courgeon, M., M. Rebillat, B. Katz, C. Clavel, and J.-C. Martin. *Life-sized audiovisual spatial social scenes with multiple characters: MARC & SMART-I2*. in *5ème Journées de l'Association Française de Réalité Virtuelle*. 2010.

D4. D'Alessandro, C. *La parole comme mouvement : glossolalies chironomiques*. in *Journées d'Etude sur la Parole*. 2010. Mons, Belgique. 1p.

D5. D'Alessandro, C. *Computerized Chironomy : Five Years of Gesture-Controlled Voice and Speech Synthesis at LIMSI*. in *International Workshop on Performative Speech and Singing Synthesis*. 2011. Vancouver, Canada.

D6. D'Alessandro, C., A. Quok, O. Deroo, D. Doukhan, R. Gelin, J.-C. Martin, C. Pelachaud, A. Rilliard, and S. Rosset. *Towards a storytelling humanoid robot*. in *AAAI 2010 Fall Symposium on Dialog With Robots*. 2010.

D7. Delprat, N., J. Basley, L. Pastur, F. Lusseyran, and T. Faure. *Investigation of the different amplitude modulated regimes observed in an experimental incompressible cavity flow*. in *European Fluid Mechanics Conference*. 2010. Bad Reichenhall, Germany.

D8. Gallay, M., M. Denis, G. Parseihian, and M. Auvray. *Egocentric and allocentric reference frames in a virtual auditory environment: difference in navigation skills between blind and sighted individuals*. in *12th European Workshop on Imagery and Cognition (EWIC 2010)*. 2010.

D9. Parseihian, G., A. Brilhault, and F. Dramas. *NAVIG: an object localization system for the blind*. in *Workshop on Multimodal Location Based Techniques for Extreme Navigation*. 2010. 2p.

D10. Parseihian, G. and B. Katz. *Recalibrating the auditory system through audio-kinesthesic training*. in *12th European Workshop on Imagery and Cognition (EWIC 2010)*. 2010.

D11. Picinali, L. and B. Katz. *Spectral discrimination thresholds comparing audio and haptics*. in *International Workshop on Haptic and Audio Interaction Design*. 2010. 40-41.

D12. Rebillat, M., E. Corteel, and B. Katz. *The SMART-I2 : a new approach for the design of immersive audio-visual environments*. in *EuroVR-EVE 2010. First EuroVR-SIGs workshop*. 2010.

D13. Robinet, J., F. Alizard, J. Basley, T. Faure, X. Gloerfelt, L. Pastur, F. Lusseyran, and N. Delprat. *Dynamics in open square cavity: from linear instability to saturated regime*. in *European Fluid Mechanics Conference*. 2010. Bad Reichenhall, Germany.

D14. Sciamarella, D. *Self-similarity in elongated pulsating jets with lateral confinement*. in *Reunión Conjunta SUF - AFA*. 2011. Montevideo, Uruguay.

D15. Silva, F., G. Artana, and D. Sciamarella. *Estudio de Turbulencia 2D con técnicas Schlieren e Interferometria*. in *Reunion sobre Recientes Avances en Fisica de Fluidos y sus Aplicaciones*. 2010. Colonia, Uruguay.

JEAN-PAUL SANSONNET

Introduction

The Research group « Architectures and Models for Interaction » (AMI), started working at LIMSI in the year 2000 on understanding and experimenting new forms of human-machine interactions. Initially focused essentially on Graphical User Interfaces (GUI), the emergence in recent years of new classes of users, new software and hardware tools and new interaction environments has shifted our attention from interfaces to people of the general public who are engaged with others in highly dynamic physical and virtual environments. Indeed, users of current computer systems are now mainly "ordinary people". They generally have only a limited knowledge of how their computers work, but they increasingly use their technical devices to engage in socio-recreational activities; expect that these devices will learn to recognize and anticipate upon their on-going and constantly changing needs; and feel happy when information is embodied in digital objects which convey attitudes and emotions that help to make that information meaningful.

We are consequently working to replace the "key-mouse-window" paradigm with an "in the world" paradigm. Acting in the world often means dealing with uncertainty by representing complex phenomena in new ways. However, understanding the world doesn't necessarily mean just processing data. Often an emotional and/or aesthetic experience is just as important, as is working hands-on with tangible user interfaces to manipulate physical objects, surfaces or spaces. Changing the world is a third theme: it requires working with others but how are solid relationships and mutual trust built up and maintained over time? Finally, the fact that more and more computing power is being incorporated into everyday objects which are capable of communicating with one another and with the people that use them is changing the world as we know it. Virtual agents are acting on their own, physical phenomena and informational phenomena are being interlaced in ambient environments. But what is the impact, what are the dangers and what are the ethical questions that have to be raised when working to build architectures and models for supporting real-world interactions?

AMI is composed of people trained in image processing, multi-modal data processing, agent technologies, signal processing, sociology and AMI cooperates widely as well, both inside LIMSI with other teams working notably on robot vision and natural language processing and externally, with industrial and scientific partners in Digiteo and other national and international research frameworks. We are in a fast moving and highly competitive field which explains why we tend to update our multidisciplinary priorities every two or three years. What follows is the structure of our research program as it was defined in the fall of 2011.

Research presentation

AMI research was structured in 2011 to reflect what we consider as being an important evolution in the domain of human/machine interactions. It is now composed of four topics:

- Topic « Image and interaction » deals with image processing for augmented reality, medical applications and robot vision. It is an area where the relationship between data processing and acting in the world is particularly important.
- Topic « Ambient and interaction » deals with new interaction issues within the context of ambient environments (interaction adaptation, merging of virtual and physical worlds, ambient modalities) and with conversational and social issues. It is where we think we can gain empirical evidence on how virtual and physical objects can be combined in order to produce meaningful, emotionally charged experiences for helping people understand the world in which they find themselves.
- Topic « Haptic interaction and communication » deals with the characterization of abstract environments, collaborative and emotional haptics and results in application to learning. It also provides us with a testbed for questions concerning the construction of mutual trust and confidence when learning to do new things together.
- Topic « Interaction with tactile surfaces » deals with the support of collaborative activities, the study of the potential of multi-touch inputs and results in several applicative fields of tactile surfaces. It also allows us to address the question of the extent to which tangible user interfaces help people understand what is required of them in a micro-world situation.

Topic 1: Image and interaction

E. Frenoux, *F. Abdin, D. Béroule, T. Bouchara, H. Ding, S. Fdili Alaoui, A. Hasasneh, C. Jacquemin, A. Osorio*

Image theme regroups several research interests concerning either augmented reality or computer vision or medical imaging. Each of them aims at developing new technologies for an automatic treatment of digital images and Human-visual environment interaction improvement.

Advanced Medical Imaging. As surgical technologies are more and more laparoscopy-oriented, surgical punctures became a wide-spread technique for diagnosis and follow-up. As the clinician has to rely on the images to make therapeutic decision and plan surgical intervention, one has to feel completely confident about medical images and to have user-friendly data representations. Our research aims at providing the practitioner tools allowing the best action possible. Since 1990, a computerized interactive system called PTM3D has been developed and enriched. It is used online, for a help to diagnosis, evaluation, surgical planning and execution. The system deals with DICOM images coming from any medical image modality, allowing volumetric segmentation and 3D visualization of anatomical structures and lesions. The research interests can be divided in three poles:

- Interactive semi-automatic segmentation of structures and lesions in a 3D environment for surgical planning
- Computation of the projection of the segmentation onto the real body's envelope, inside the operating room, to allow the surgeon to see through the patient's body (Illustration 1).
- Real-time follow-up of surgical tools, using a webcam, to validate the operation course with respect to the initial planning.

Clinical applications are driven in collaboration with several French, Spanish, English and American hospitals, and concern kidney surgery, gastroplasty and hepatectomy. The main characteristic of the system is that the surgical protocol isn't modified by the use of our tools, as it only needs visual projections. One can see several applications on the following webpage: http://perso.limsi.fr/osorio/
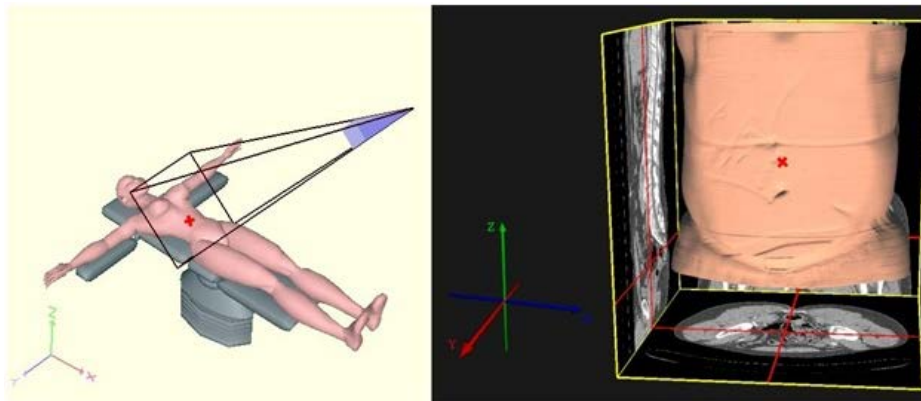
Illustration 1 – Projection computation for online surgery helping, a screen capture: the orientation of the projector is computed from the puncture path (displayed right, with CT images for control) and the patient's body inclination (displayed left, with the projector and the entrance point for the puncture).

Image Processing for Augmented Reality and for Robotic Vision. Image processing for augmented reality. For Spatial Augmented Reality (i.e. using video-projection to overlay physical space with visual digital data), it is necessary to calibrate the image projected onto the physical world, in order to find its optimal position. This point is developed through an external collaboration. In addition to the core calibration issues, Spatial Augmented Reality raises many image processing challenges, such as:

- Computing projection masks so that visual augmentation can be limited to subsets of a real scene (e.g. spectators shadows)
- Real-time image transformation to re-project it onto the scene, after modification (e.g. contour delineation)
- Human-scene interaction management.

All the algorithms are implemented on the Graphic Processing Unit in order to optimize processing time and make them compatible with real-time interaction.

Concerning calibration and real-time images correction, a research collaboration has been developed with IEF (team ACCIS). This work should allow rebuild the physical world geometry and use it for computing image correction on plane parts of the physical scene.

Our research concerning Spatial Augmented Reality is used in various projects: for built heritage augmentation, for interactive installations in public spaces, and more generally, for some of the art/science applications described in VIDA transversal theme.

Three PhD's are currently studying applications and extensions of image processing for Augmented Reality: Hui Ding is studying audio-graphic scenes descriptions and rendering in the framework of the ANR Topophonie project. Her results can be applied to audio and visual augmentations of physical scenes. Tiffanie Bouchara is developing comparative analysis methods for visual and auditory perceptions in audio-graphic scenes. Sarah Fdili Alaoui PhD proposes new perspectives for gesture interaction using the whole body and motion analysis in collaboration with IRCAM.
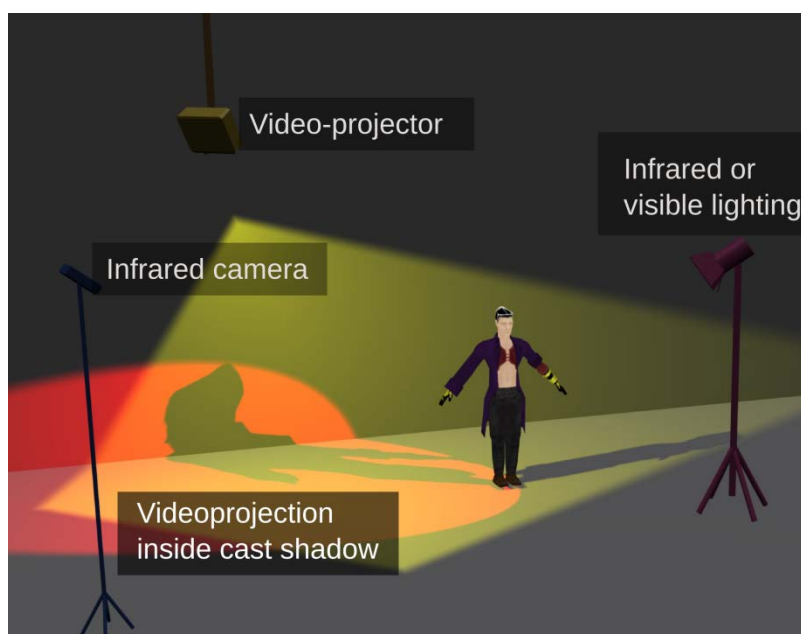
Illustration 2 – PICRI project "Toute la lumière sur l'ombre", in collaboration with didascalie.net and "L'ange Carasuelo" companies and with Taverny's library "Les Temps Modernes": real-time image processing for video-projection inclusion in shadows or in a silhouette captures.

Image Processing and Robotic Vision. This theme is the object of collaboration with members of the CPU group of the LIMSI (see the "Perceptual Systems and Models" topic in the CPU group). The PhD of Ahmad Hasasneh concerns the development of machine learning methods for semantic place recognition and robot localization.

Topic 2: Ambient and interaction

Y. Bellik, *D. Béroule, A. Gharsellaoui, A. Mohamed, G. Pruvost, J.P. Sansonnet, B. Turner*

Classical WIMP interaction models are not adequate within the context of ambient environments due to users' mobility, interaction devices heterogeneity, interaction context variability… Hence, there is a need of new interaction models that will suit well users' needs in ambient environments.

Interaction Adaptation. A major issue of interaction in ambient environments concerns the interaction adaptation due to the highly dynamic variability of devices and physical environment properties. Having developed the WWHT model which allows adapting dynamically the presentation of information using different modalities, we started an analysis work to see if this model can be reused in the context of ambient environments. This analysis lead us to identify two significant limitations of the WWHT model: 1. The WWHT model could only manage output modalities; 2. the context information representation was too specific. To overcome these limitations, we have proposed two main extensions to the WWHT model. The first extension

consists in adapting the model so that it becomes capable of handling interactions in both sides (input and output). Hence, the concept of Off-the-shelf Interaction Object (OIO) that represents pieces of interactive software able to provide interaction through different input and output modalities was introduced. The second extension concerned the representation of context information within the model. We decided to switch to an ontology based modelling of the interaction context. The use of ontologies allows the designer to write rules for user interaction adaptation in generic terms. This extended model has been used successfully in the ATRACO European project.

Merging Virtual and Physical Worlds. Another important issue in ambient environments concerns the definition of interaction models that allow the harmonious merging of the virtual and physical worlds. Thanks to collaboration with the "Conversational Agents" research topic of group CPU, we have integrated a virtual agent in our ambient platform (IRoom) and embedded it with location-aware capacities that allow the virtual agent to point at real objects of the real world. We conducted an experimental evaluation comparing this agent with an agent that does not perceive nor use the location of users and objects. The location-aware agent elicited higher levels of perceived presence and perceived adaptivity (See Illustration 3).

Ambient conversational modalities. We want also to explore interaction modalities that could improve in future ambient environments the psychological well-being of ordinary people. One of the major issues is the global acceptability of such systems, which raises the question of the kind of relationship a person can establish with her/his ambient, viewed as an intentional entity. Recent research on conversational agents has upheld their ability to facilitate the link between users and computer systems. In this context, we have envisioned the integration of such agents in ambient systems, along three main directions:

- Assistant Conversational Agents: handle the function of assistance when it is explicitly requested by users, for example through questions put in natural language. The conversational situations are defined according to the role endorsed by the agent: presenter, teacher, coach etc.
- Rational and Behavioral (R&B) agents: deal with the integration of psychological phenomena, such as personality traits, into assistant agents. In particular, we have proposed the R&B architecture for the generic implementation of the psychological behaviors of the FFM taxonomy in terms of influence operators over the rational decision making process of artificial agents.
- Personification of ambient systems: for people to establish a closer relationship, it is necessary for an ambient to exhibit in its interactions, elements that could be interpreted by users as character cues. In this context, a first model about the expression of "ambient's emotions and traits" through ambient output modalities has been proposed. Furthermore, we have defined a model for the natural language interaction between users and abstract topics (in relation with work in social informatics – see below) that focuses on the expression of emotions and traits in abstract entities. Aimed at the longer-term, a neurobiological model of Decision-Making has been designed, in which the system choices depend upon its "emotional" experience.

Social Informatics. Finally, from a social informatics point of view, ambient environments are places where people meet, get to know one another and decide to do things together collectively. We are looking specifically at two issues. The first one concerns the emergence of a desire to cooperate with people that you've just met. For that, people generally have to understand what is expected from them. For example, in relation with the work on personification mentioned above, we have started to personify ambient systems by using agents to help clarify what is at stake in a given cognitive and social situation. However, even when people see the interest of cooperating, before engaging in this collaboration they often need assurance that they will be rewarded for investing their time and effort in trying to do things with others. This, then, is the second question: how confidence in the solidity and mutual respect and reciprocity of social relationships built up? We consider that appropriate linguistic behaviour in a flow of conversation is crucial and are studying how words can trigger confidence reinforcement mechanisms in ambient systems.
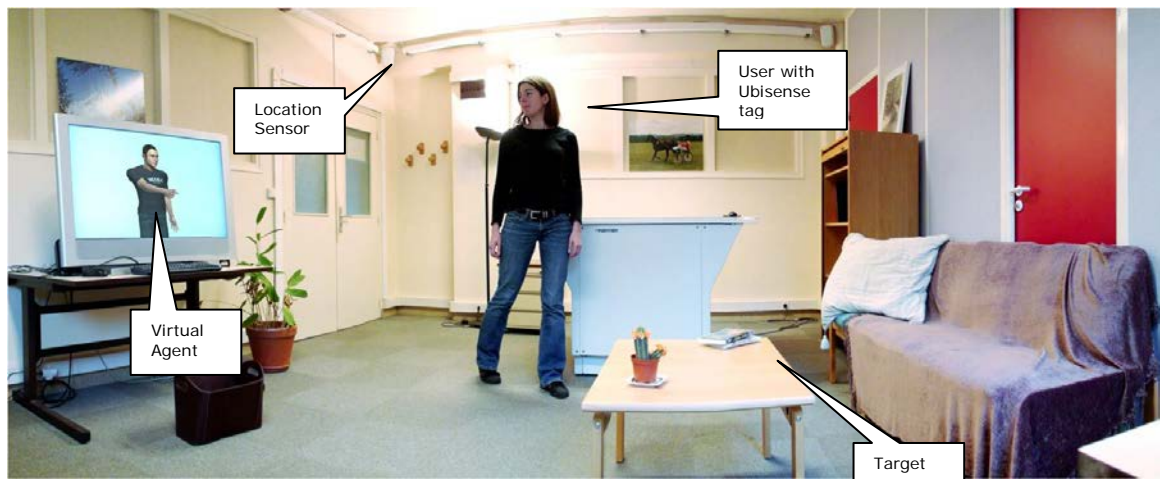
Illustration 3 - An experiment conducted in the IRoom (Intelligent Room) in collaboration with the "Virtual Agents and Emotions" research topic of group CPU. Users and objects are tracked thanks to the Ubisense location system. Users have to find some objects disseminated in the IRoom with the help of a virtual agent. Two experiment conditions were tested: 1- a virtual agent that does not perceive nor use the location of users and objects; 2- a location-aware virtual agent that adapts its spatial behaviour to users' and objects' locations during the search task and who is capable of pointing at real objects in the real world.

Topic 3: Haptic interaction and communication

__M. Ammi__, Y. Bellik, J. Simard, A. Girard, F. Gueniat, Y. Gaffary

In the landscape of research in haptics, we study and investigate the role of the haptic channel for the analysis and learning of complex and abstract environments and beyond, we would like to investigate the use of the haptic channel for the support of interpersonal communication. We can summarize our research in four main axes.

Characterization of abstract environments. This research begins as a collaboration with the team AERO, dealing with perception of CFD data in the mechanics department at LIMSI. Several haptic rendering algorithms were developed according various constraints of CFD data (discontinuities, variation of gradient, etc.). Afterwards, we proposed to develop a complete approach for the analysis Eulerian structures in complex flow including several vortices. This first experience entailed the Digiteo project (FLUCTUS, Digiteo) aiming at accelerating the calculation of Lagrangian structures. The investigated approach combines new optimization methods and human centered strategies for the orientation of calculation according the progress of calculation.

Collaborative haptics. The role of haptics in molecular structures manipulation was followed by a study on the role of haptics for the coordination of actions of several users during collaborative manipulations of molecular structures. The objective is to improve the distribution of the workload between involved users. This research begins with several experimental studies to understand the contributions and the limits of collaborative strategies for the manipulation of closely coupled structures. These experiments highlight several communication constraints, which limit the working efficiency. Based on these results, we studied and designed different collaborative metaphors for usual collaborative actions like the collaborative selection, designation of targets (Illustration 4), synchronous manipulation of structures, and collaborative search of targets. These metaphors were studied with new experimental approaches to highlight their roles for the improvement of interpersonal awareness (FRESCO project, ANR).

Affective communication. The use of virtual humans for the communication of emotions showed limitations for the recognition of some emotions, and some difficulties for the differentiation of close emotions. To improve the communication of critical emotions, we propose to complete the visual feedback with a suitable haptic feedback. This research started with the analysis of haptic expressions used by subjects to express a set of emotions. Based on advanced analysis approaches (ANOVA, ACP and EM) according several physical factors (velocity, fluidity, etc.), and perceptual experiments, we defined one haptic expression for each investigated emotion. These haptic expressions were combined with visual expressions to study the complementarities between the two feedbacks, and contribution of the haptic channel to improve the level of recognition and differentiation of close emotions. Beyond the communication of emotions with virtual humans, we investigate and design a haptic interpresence platform for the real time

communication of emotions between two remote users (Canal Haptic project, OSEO).

Learning with haptics. This axis includes several collaborations which aim at developing learning platforms for undergraduate students and disabled people. Collaboration with the teams AERO of the mechanics department and CPU of the Human-Machine Communication department at LIMSI has been established in order to design a learning platform for dynamic systems (*e.g.*, pendulum). The proposed approach should improve the understanding of the relation between the real physical system and the corresponding abstract representation (3D attractors) in the phase's space. A second collaboration with colleagues at IUT of Orsay was initiated to study and design a learning platform for blind people. This platform concerns the study and the exploration of electronic circuits with the haptic channel.
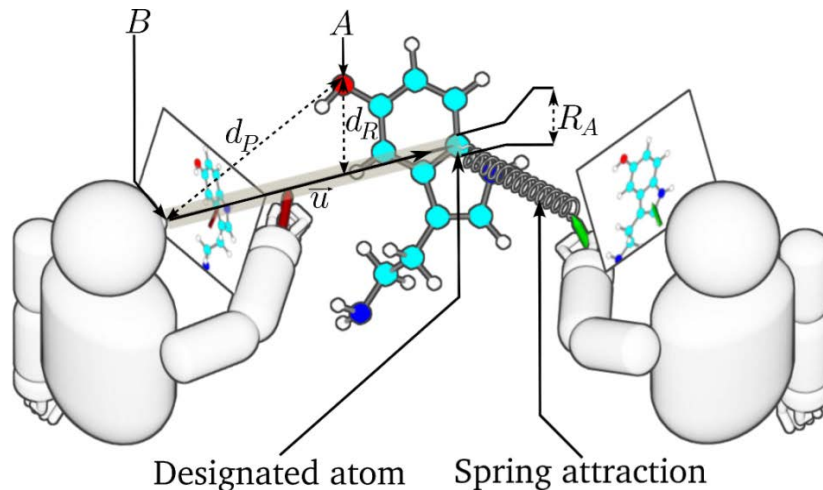
Illustration 4 – Collaborative Metaphor for Haptic Pointing: Based on the image–plane pointing technique and a spring–time attraction model, we propose to guide physically the partner to the designated target. Experiments were carried out in the context of a molecular deformation procedure and according to different collaborative working strategies. The results show a significant improvement of the performance and efficiency for the different steps of collaborative tasks.

Topic 4: Interaction on tactile surfaces

F. Vernier, *R. Ajaj, G. Besacier, J. Chaboissier, C. Perin, E. Pointal*

Interactive surfaces have evolved since the inspiring vision from Pierre Wellner. A decade (1991-2001) was necessary before this first prototype generate an explosion of research works. This explosion began with four pioneering projects: DiamondTouch from Paul Dietz at MERL, Smarskin from Jun Rekimoto at Sony CSL, the FTIR family of Do-It-Yourself (DIY) tables initiated by Jeff Han in 2005 and the Microsoft Surface commercially distributed in 2007.

At LIMSI, the theme Interaction on Tactile Surfaces includes many works in this area that we can organize in three categories. First, our approach first question the WIMP paradigm (Windows-Icon-Menu-Pointer) by observing users collaboratively manipulating the interface of an interactive table. Indeed interactive surfaces suggest the disappearance of the mouse pointer(s) but windows and menus must also be revisited. The second axis of our approach is then to seek new forms of interaction based on the extraordinary potential of multi-touch inputs (richness, easy learning, etc.). Illustration 5-a shows for instance how multitouch input can be naturally mapped to the complex manipulation of fisheye lens. Finally, we start, like many colleagues of the community, to seek for application domains to encounter a hit with users (game, architecture / urban planning, map making, brainstorming, etc.). Illustration 5-b illustrates the application of group brainstorming around a tabletop setting with the help of the system to keep the pace of the collaborative work.
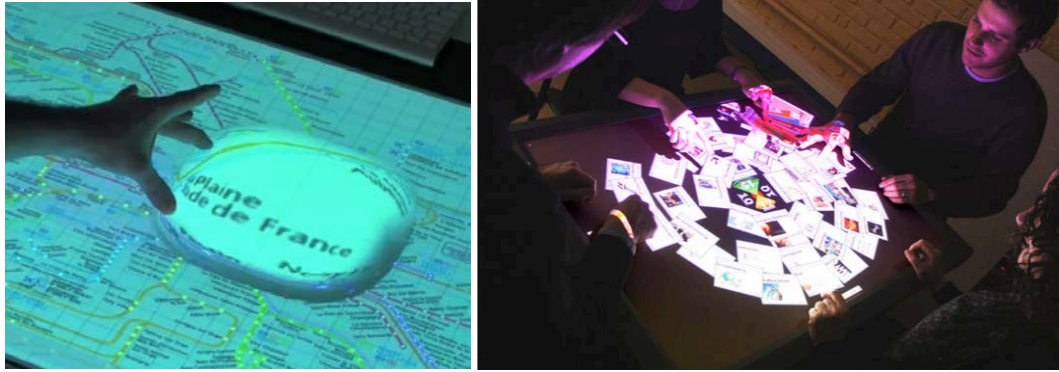
*Illustration 5 – a: Multitouch input for the complex manipulation of fisheye lens
b: Group brainstorming around a tabletop*

The commercial future of Tactile surfaces is still uncertain in the industrial world due to tensions between competitors. The tactile surfaces of Apple are gaining in size and resolution and Microsoft and Samsung just revealed the much bigger tabletop "surface v2.0" with support of objects recognition. Beyond the rivalry between the industry leaders, current research focuses now less on hardware and more on software. The approach at LIMSI is to focus on new application domains such as information visualization and on challenges for toolkits (like Web or Java toolkits). Furthermore we believe new methodological tools are to be invented to study group work around an interactive tabletop setup.

Highlights

- IRoom: developing of a technological platform dedicated to the support of experimentations about modalities and human interaction in ambient environments. The IRoom platform has been launched in 2010 and is being used since in several LIMSI studies and research collaborations with Supélec.
- Divalite: free software toolkit dedicated to the integration of embodied conversational agents into Web pages supporting research experimentations on assistant an pedagogical agents. This software has been developed in collaboration with group ISLE at LIMSI and Brasilian UNISINOS University in the PRAIA project (Capes-Cofecub).
- J-P. Sansonnet has been appointed chair of the Scientific Committee of Conference JFSMA 2011.

Staff

Permanent Staff

Firstname	Lastname	Type of position	Employer	HDR	Arrival date	Departure date
Mehdi	Ammi	Ass. Prof.	U-PSud			
Yacine	Bellik	Ass. Prof.	U-PSud	HDR		
Dominique	Béroule	CR	CNRS			
Emmanuelle	Frenoux	Ass. Prof.	U-PSud			
Christian	Jacquemin	Prof.	U-PSud	HDR		
Angel	Osorio Sainz	DR	CNRS	HDR		
Laurent	Pointal	Res. Eng.	CNRS			
Jean-Paul	Sansonnet	DR	CNRS	HDR		
William	Turner	Res. Eng.	CNRS			
Frédéric	Vernier	Ass. Prof.	U-PSud			

PhD Students

Firstname	Lastname	Graduate school	University	Type of support	Start date	Date of defense
Fadi	Abdin	STITS	U-PSud	Syrie PhD grant	01/12/2006	

Guillaume	Besacier	EDIPS	U-PSud	Ile de France PhD grant	01/10/2006	09/09/2010
Jonathan	Chaboissier	EDIPS	U-PSud	MNRT PhD grant	01/10/2008	20/12/2011
Sonia	Dahdouh	EDIPS	U-PSud	MNRT PhD grant	01/10/2007	23/09/2011
Hui	Ding	EDIPS	U-PSud	CDD CNRS ANR TOPOPHONIE	01/11/2009	
Sarah	Fdili Alaoui	EDIPS	U-PSud	U-PSud PhD grant	01/10/2009	
Yoren	Gaffary	EDIPS	U-PSud	U-PSud PhD grant	01/10/2011	
Asma	Gharsellaoui	EDIPS	U-PSud	U-PSud PhD grant	01/10/2011	
Adrien	Girard	EDIPS	U-PSud	U-PSud PhD grant	01/10/2010	
Ahmad	Hasasneh	EDIPS	U-PSud	Israël PhD grant	02/11/2009	
Ahmed	Mohamed	STITS	U-PSud	CDD SUPELEC	01/11/2009	
Julien	Nauroy	EDIPS	U-PSud	MNRT PhD grant	01/10/2006	09/12/2010
Charles	Perin	EDIPS	U-PSud	U-PSud PhD grant	01/10/2011	
Gaëtan	Pruvost	EDIPS	U-PSud	CDD CNRS ATRACO	01/09/2008	
Jean	Simard	EDIPS	U-PSud	MNRT PhD grant	01/10/2008	31/01/2012

Non permanent staff

Firstname	Lastname	Type of position	Employer	Arrival date	Departure date
Guillaume	Besacier	Post-Doc	CNRS	01/09/2010	30/09/2011
Wai Kit	Chan	Post-Doc	CNRS	01/01/2010	31/07/2010
Céline	Clavel	Post-Doc	CNRS	01/03/2009	31/12/2010
Maria Victoria	Eyharabide	CDD	CNRS	02/08/2010	31/12/2012
Jorge	Garcia-Flores	Post-Doc	CNRS	01/02/2010	30/04/2012
Laurent	Garnier	Post-Doc	CNRS	01/12/2009	31/01/2010
Elisabeth	Pointal	Support Eng.	CNRS	17/10/2011	31/08/2013
Issam	Rebai	Post-Doc	CNRS	01/04/2009	31/03/2010
Jean	Simard	Post-Doc	CNRS	16/12/2011	31/08/2012
Chahnez	Zakaria	Associate Researcher	CNRS	01/10/2011	31/08/2012

Indicators of scientific notoriety

Prizes and awards

- Bouchet F., Sansonnet J. P., Influence of personality traits on the rational process of cognitive agents, Best paper award at 2011 IEEE/WIC/ACM International Conferences on Web Intelligence and Intelligent Agent Technology, August 23-25 2011, Lyon, France, pp 81-88
- Asfari O., Doan B. L., Bourda Y. Sansonnet J. P., Context-based Hybrid Method for User Query Expansion, In: Proceedings of the fourth international conference on Advances in Semantic Processing. SEMAPRO 2010, pp 69-74, Florence, Italy, 25-30 october, 2010, best paper award

Editorial board appointment

- Y. Bellik is member of the editorial board of JIPS (Journal d'Interaction Personne-Système)
- Y. Bellik is editor of the special issue "Informatique Ambiante" of TSI (Technique et Science Informatiques), to be published 2012.
- Ch. Jacquemin is coeditor of the Special Issue "Art & Informatique" of TSI Journal to appear in 2012
- J-P. Sansonnet is member of steering committee of national TSI journal
- J-P. Sansonnet is member of scientific board of international journal Scientia
- J-P. Sansonnet is member of scientific board of international journal JACR
- J-P. Sansonnet is editor of special issue of journal TSI 2011 on Conversational Agents
- J-P. Sansonnet is editor of special issue of journal RIA 2012 on Multi-agent systems
- W. A. Turner is member of board of journal "la Revue d'Anthropologie des Connaissances"

Organization of international or national scientific events

Member of the scientific, technical program and/or organizational committees for international/national conferences or workshops

- M. Ammi is chair of the workshop "Haptics for Telepresence, Teleoperation and Collaborative Environments", IEEE-TCH / EuroVR Haptic-SIG, 13th Virtual Reality International Conference, April 6-

8, 2011, Laval, France
- Y. Bellik is member of the program committee for the 14th ACM International Conference on Multimodal Interaction (ICMI 2012) Demo and Exhibition session, Oct 22-26, Santa Monica, CA.
- Y. Bellik is member of the program committee of ACM International Workshop Smart Gadgets Meet Ubiquitous and Social Robots on the Web (UbiRobots'12), Pittsburgh, PA, USA, Sep. 8, 2012
- Y. Bellik is member of the program committee of AIeIA 2012, 1st Artificial Intelligence in Education Workshop: Innovations and Applications, in the context of 8th AIAI Conference, 27-30 September 2012, Halkidiki, Greece.
- Y. Bellik is member of the program committee of IE11, 7th International Conference on Intelligent Environments, 25—28 July 2011, Nottingham, UK.
- Y. Bellik is member of the scientific committee of VRIC 2011, Symposium on Haptics for Telepresence, "Teleoperation and Collaborative Environments", 13e Rencontres Internationales de la Réalité Virtuelle et des Technologies Convergentes, 6—10 Avril 2011, Laval, France.
- Y. Bellik is member of the program committee of IE10, 6th International Conference on Intelligent Environments, 19—21 July 2010, Monash University, Kuala Lumpur, Malaysia.
- Y. Bellik is member of the program committee of SmartE 2010, IEEE PerCom Workshop on Smart Environments, Eighth Annual IEEE International Conference on Pervasive Computing and Communications, Mannheim, Germany, March 29 - April 2, 2010.
- Y. Bellik is member of the program committee of Advances in Mobile Computing and Applications: Security, Privacy and Trust, International workshop in conjunction with the 24th IEEE AINA conference — 20-23 April 2010, Perth, Australia.
- Ch. Jacquemin is coorganizer of the workshop Audio-graphic Modeling and Interaction at NIME 2011
- J-P. Sansonnet is president of scientific committee and member of steering committee of national conference JFSMA'11
- W. A. Turner is organizer of International Meeting on "talent mobility between Europe and Latin America", Paris, November 2 – 7, 2011
- F. Vernier is member of scientific board of the 6th conference on Interactive Tabletops and Surfaces, Cambridge, USA 11-14 nov 2012Invited lectures, talks or seminars

Invited lectures, talks or seminars

Invited workshop speaker

- M. Ammi, "Haptics for CVE", workshop on Hot Topics in Multimedia Research, New York University in Abu Dhabi (NYUAD), United Arab Emirates, May 2-3, 2012
- Y. Bellik, "Interaction Multimodale et Applications au Handicap Visuel", International Workshop IHM 2012, Sousse, 15-18 Juin 2012

Tutorial at workshops or conferences or summer schools

- J-P. Sansonnet, "Agents Conversationnels dans l'Internet", at summer school on Web Intelligence, Lyon, july 8-10, 2010

Invited talk (national or international)

- J-P. Sansonnet, "Intelligent Virtual Agents in the Internet", at Laboratory LITIS, Rouen, june 3, 2010

International or national scientific networking

International networks

- M. Ammi is vice leader of the EuroVR Special Intereset Group on Haptics (EuroVR Haptic SIG)
- M. Ammi is vice chair for Industrial Relationship at the IEEE Technical Committee on Haptics (IEEE TCH)
- M. Ammi is member of the European Association for Virtual Reality and Augmented Reality (EuroVR)
- M. Ammi is member of the EuroHaptics Society (EuroHaptics)
- Y. Bellik is member of the Pervasive Adaptation Research Network (PerAda).
- Y. Bellik is member of the FOCAS (Fundamental of Collective Adaptive Systems)
- W. A. Turner is member of the International Research Consortium working on Talent Mobility and its impact on socio-economic development (EuropAid Program of the European Union)
- Ch. Jacquemin is in the Steering Committee of the US National Science Foundation -- funded Network for Sciences, Engineering, Arts and Design (SEAD: *http://sead.viz.tamu.edu/*)

National networks or working groups

- M. Ammi is member of the French Virtual Reality Association: AFRV
- Y. Bellik is member of the "Association Francophone d'Interaction Homme-Machine" (AFIHM).
- Y. Bellik is member of the CESAME working group, "Conception et Evaluation de Systèmes interactifs Adaptables et/ou MixtEs", working group of GDR-I3.

- J-P. Sansonnet is co-animator of the working group Animated Conversational Agents (GT ACA) of GDR I3 (2006-2012).
- Ch. Jacquemin is animator of "La Diagonale Paris-Saclay", pôle d'activités de médiation et de collaborations arts/sciences.

Participation in evaluation or expertise committees

National committees (CoNRS, CNU, CCSU…)

- W. A. Turner is appointed member the CNRS "Commission Administrative Paritaire" for "Ingénieur d'études", 2010-2012

Expert for scientific evaluation committees

- M. Ammi is expert for the International cross-cutting programs of the ANR, 2011
- Y. Bellik is expert for the CONTINT (Contenus numériques et interactions) program of ANR, 2011.
- Y. Bellik is expert for the JCJC (Jeune Chercheuse – Jeune Chercheur) program of the ANR, 2010.
- J-P. Sansonnet is co-evaluator for AERES (LISTIC lab, Annecy), 2010

Member of the administration or advisory board

- J-P. Sansonnet is president of the scientific committee of Cluster ISLE of région Rhône-Alpes, 2010 - 2011
- J-P. Sansonnet is member of the scientific committee of Supélec (section computer science), 2010 - 2012

Member of selection juries

- M. Ammi was member of the selection committee for the position MCF n° 4027 of Univ. Evry Val d'Essonne, 2012
- Y. Bellik is member of the selection committee for the position MCF n° 1356 of Univ. Joseph Fourier, Grenoble, 2010
- Y. Bellik is member of the selection committee for the position MCF n° 1690 of Univ. Paris-Sud, Orsay, 2010
- Y. Bellik is member of the selection committee for the PRAG positions of IUT d'Orsay, 2009-2010.
- Y. Bellik is member of the selection committee for the position MCF n° 1643 of Univ. Paris-Sud, Orsay, 2009
- E. Frenoux of member of CCSU27 of Paris-Sud
- W. A. Turner is president of CNRS Jury for "BAP 5 concours interne, Ingénieur de Recherche", 2012

Teaching activities and duties in relation to research

- M. Ammi teaches in Master 2 of computer science research (Interaction) of Paris-Sud (head of option: Haptics), 2011-2012
- M. Ammi is the head of the multimedia classroom project, Univ. Paris-Sud / Polytech Paris-Sud
- Y. Bellik is head of the Human-Machine Interaction course at Supélec engineer school, 3rd Year.
- Y. Bellik teaches in Master 2 of computer science research (Interaction) of Paris-Sud (head of option: Interaction multimodale Intelligente), 2011-2012
- Ch. Jacquemin teaches in Master 2 of computer science research (Interaction) of Paris-Sud (option: Virtual Humans), 2011-2012
- Ch. Jacquemin teaches with J-M. Vézien, in Master 2 professional (IICI) of Paris-Sud (track: GPU Programing GPU and Image processing), 2011-2012
- J-P. Sansonnet teaches in master 2 of computer science research (IAC) of Paris-Sud (option: Multi agent systems), 2010-2012
- W. A. Turner teaches in master "Patrimoine immatériel et information scientifique, technique et économique" (PISTE), Université de Marne La Vallée
- F. Vernier participates in Master 2 of computer science research (Interaction) of Univ. Paris-Sud (option: Infovis) 2012

Dissemination and vulgarization

- M. Ammi was the head of the Art and Technology show "Canal Haptique", at Futur en Seine, 2011
- Ch. Jacquemin is animator of "Journées Arts/Sciences" of University of Paris-Sud, Orsay, may 2012
- Ch. Jacquemin is animator of Atelier "Visualisation de Particules", La Diagonale, Orsay, june 2012
- J-P. Sansonnet has participated at the theater creation "Excursions DEFICELONS" of Jean-François Peyret on the topic of the relationship between living actors and virtual actors about the Walden of Thoreau, Theater Paris-Villette, june 7-10, 2010

Research Conventions and Contracts

Valorization

- Y. Bellik and G. Pruvost, Youpi : Open source UPNP software library, developed in the context of the ATRACO European project (http://sourceforge.net/projects/youpi/files/)
- W. A. Turner: UNOPORUNO, a Free License Software, for computer supporting sociological research into the impact of talent mobility on socio-economic development

Contract table

Acronym	Funding agency/Partner	Program	Nature	Resp. for LIMSI	General coordinator	Starting date	Ending date	LIMSI share
BUIS - Confidentialité	ANR	other	Non-disclosure agreem.	Turner W.	Joel Reboul	01/03/2006	01/03/2014	
SEVEN-confidentialité	EDF	other	Non-disclosure agreem.	Jacquemin Ch.	Jacquemin Ch.	15/03/2006	15/03/2016	
CARE	ANR	RIAM	Research collab.	Martin J.-C.	De La Rivière J.-B. (IMMERSION)	05/12/2007	04/12/2010	93987
ATRACO	UE	SMCP	EU contract	Bellik Y.	Bellik Y.	01/02/2008	30/07/2011	361320
Prototype d'écran haut parleur	Sonic Emotion		Research collab	Katz B.	Katz B.	03/03/2008	02/09/2011	
AUTISME	Fondation de France		Research collab.	Martin J.-C.	Grynszpan O. (Emotion-UPMC)	16/06/2008	15/06/2010	24000
WILD	Digiteo		Research collab.	Vernier F.	Pietriga E. (INRIA Saclay)	15/07/2008	15/05/2012	17160
Futurs en Seine	Région Ile de France		Research collab.	Jacquemin Ch.	Jacquemin Ch.	27/11/2008	26/11/2010	35716
PICRI	Région Ile de France		Research collab.	Jacquemin Ch.	Jacquemin Ch.	27/11/2008	26/11/2011	74500
Alicante	Fundacion de la Comunidad Valenciana		Research collab.	Osorio Sainz A.	Osorio Sainz A.	01/12/2008	01/12/2013	
CIDESAL	IRD		EU contract	Turner W.	Meyer J.-B. (LPED)	01/03/2009	31/05/2012	102400
EVEILS	ANR	Basic Science	Research collab.	Vézien J.-M.	Parizot E. (APC)	01/05/2009	31/08/2012	159085
Copperlan	KLAVIS	other	other	Vernier F.	Vernier F.	01/07/2009	01/07/2011	
Topophonie	ANR	CONTINT	Research collab.	Jacquemin Ch.	Cahen R. (ENSCI)	01/10/2009	30/09/2012	185695
	SUPELEC	PhD co-supervision	Research collab.	Bellik Y.	Bellik Y.	01/11/2009	31/10/2012	
	IRCAM	PhD co-supervision	Research collab.	Jacquemin Ch.	Jacquemin Ch.	01/11/2009	31/10/2012	
WILD PCRI	Digiteo	Projet Emergent	Research collab.	Vernier F.	Beaudouin-Lafon M. (LRI)	15/07/2010	14/07/2011	5940
FLUCTUS	Digiteo	Projet Emergent	Research collab.	Pastur L.	Pastur L.	01/09/2010	31/08/2013	111288
SUSTAINS	OSEO		Research collab.	Vernier F.	Mahé E. (Artefacto)	10/12/2010	09/01/2014	122300
Canal Haptique	OSEO		AIMA	Ammi M.	Ammi M.	21/01/2011	21/02/2012	29900
FRESCO	ANR	JCJC	Research collab.	Auvray M.	Auvray M.	01/10/2011	30/09/2014	169941

Scientific publications

Doctoral theses and HDR

T1. Besacier, G., *Interactions post-WIMP et applications existantes sur une table interactive* 2010, thèse de l'Université Paris-Sud. Soutenue à LIMSI, Orsay, le 19 octobre 2010, 159 p.

T2. Bouchet, F., *Conception d'une chaîne de traitement de la langue naturelle pour un agent conversationnel assistant* 2010, thèse de l'Université Paris–Sud. Soutenue à LIMSI, Orsay, le 29 juin 2010, 317 p.

T3. Chaboissier, J., *Interactions simultanées de plusieurs utilisateurs avec une table interactive* 2011, thèse de l'Université Paris-Sud. Soutenue à LIMSI, Orsay, le 20 Décembre 2011, 169 p.

T4. Dahdouh, S., *Filtrage, segmentation et suivi d'images échographiques : applications cliniques* 2011, thèse de l'Université Paris Sud. Soutenue à LIMSI, Orsay, le 23 septembre 2011, 207 p.

T5.   Nauroy, J., *Traitements interactifs d'images radiologiques et leurs applications cliniques* 2010, thèse de l'Université Paris-Sud. Soutenue à LIMSI, Orsay, le 26 novembre 2010, 264 p.

Articles in peer reviewed scientific journals

A1.   Abdin, F. and A. Osorio Sainz, *An efficient ant colony optimization clustering algorithm.* Ubiquitous Computing and Communication Journal, 2011. **6** (4): pp.15-21.

A2.   Asfari, O., B. Doan, Y. Bourda, and J.-P. Sansonnet, *Personalized access to contextual information by using an assistant for query reformulation.* International Journal on Advances in Intelligent Systems, 2011. **4** (3-4): pp.128-146.

A3.   Awde, A., M. Miraoui, C. Tadj, and Y. Bellik, *Modeling and Simulation of a Pervasive Multimodal Multimedia Computing System for Visually-Impaired Users.* Int. J. Adv. Comp. Techn., 2010. **2** (3): pp.6-14.

A4.   Bouchet, F. and J.-P. Sansonnet, *Agents conversationnels psychologiques : un cadre d'étude des comportements rationnels et psychologiques des agents assistants conversationnels.* Revue d'Intelligence Artificielle (RIA), 2011. **25**: pp.591-623.

A5.   Bourdot, P., T. Convard, F. Picon, M. Ammi, D. Touraine, and J.-M. Vézien, *VR-CAD integration : multimodal immersive interaction and advanced haptic paradigms for implicit edition of CAD models.* Journal of Computer-Aided Design, 2010. **42** (5): pp.445-461.

A6.   Braffort, A., J.-P. Sansonnet, J.-C. Martin, and C. Verrecchia, *Diva, une architecture pour le support des agents gestuels interactifs sur internet.* Technique et Science Informatiques, numéro spécial sur les Agents Conversationnels Animés, 2010. **29** (7): pp.777-806.

A7.   Buisine, S., G. Besacier, A. Aoussat, and F. Vernier, *How do interactive tabletop systems influence collaboration ?* Computers in Human Behavior, 2011. **28** (1): pp.49-59.

A8.   Delprat, N., C. Leroux, and S. Fdili Alaoui, *Experience of a cloud-avatar: Scientific challenges and artistic perspectives.* International Journal of Design and Innovation Research (IJODIR), 2011. **6** (1): pp.127-143.

A9.   Fang, X., C. Jacquemin, and F. Vernier, *WEBCONTENT visualizer: a visualization system for search engines in semantic web.* International Journal of Information Technology & Decision Making, 2011. **10** (5): pp.913-931.

A10.   Grynszpan, O., J. Nadel, J. Constant, F. Le Barillier, N. Carbonell, J. Simonin, J.-C. Martin, and M. Courgeon, *A new virtual environment paradigm for high functioning autism intended to help attentional disengagement in a social context.* Journal of Physical Therapy Education, 2011. (25): pp.42-47.

A11.   Heinroth, T., A. Kameas, G. Pruvost, L. Seremeti, Y. Bellik, and W. Minker, *Human-computer interaction in next generation ambient intelligent environments.* Intelligent Decision Technologies: an International Journal, 2011. **5** (1): pp.31-46.

A12.   Jacquemin, C., R. Ajaj, S. Le Beux, C. D'Alessandro, M. Noisternig, B. Katz, and B. Planes, *Organ augmented reality: audio-graphical augmentation of a classical instrument.* International Journal of Creative Interfaces and Computer Graphics, 2010. **1** (2): pp.51-66.

A13.   Jacquemin, C., R. Ajaj, and B. Planes, *Alice on both sides of the looking glass: performance, installations, and the real/virtual continuity.* Computers in Entertainment, 2011. **9** (3): pp.23.

A14.   Menelas, B., M. Ammi, P. Bourdot, and S. Richir, *Survey on haptic rendering of data sets : exploration of scalar and vector fields.* Journal of Virtual Reality and Broadcasting, 2010. **6** (9): pp.11p.

A15.   Milletto, E., M. Pimenta, F. Bouchet, J.-P. Sansonnet, and D. Keller, *Principles for music creation by novices in networked music environments.* Journal of New Music Research, 2011. **40** (3): pp.205-216.

A16.   Xuetao, M., J.-P. Sansonnet, and F. Bouchet, *Définition d'un agent conversationnel assistant d'applications Internet à partir d'un corpus de requêtes.* Revue de Technique et Science Informatiques (TSI), 2011. **29** (10): pp.1123-1154.

Books & chapters in books

B1.   Buisine, S. and J.-C. Martin, *The influence of user's personality and gender on the processing of virtual agents' multimodal behavior*, in *Advances in Psychology Research, vol. 65: The Psychology of Extraversion, Chapter 14*, A.M. Colombus, Editor. 2010, Nova Science Publishers. pp. 289-302.

B2.   Castellano, G., K. Karpouzis, C. Peters, and J.-C. Martin, *Journal on multimodal user interfaces. Special issue "Real-time affect analysis and interpretation : closing the affective loop in virtual agents and robots" volume 3, number 1-2, mars 2010* 2010: Springer. 153pp.

B3.   Cowie, R., E. Douglas-Cowie, J.-C. Martin, and L. Devillers, *The essential role of human databases for learning in and validation of affectively competent agents*, in *Blueprint for Affective Computing. A sourcebook*, K.R. Scherer, T. Banziger, and E. Roesch, Eds. 2010, Oxford University Press. pp. 151-165.

B4.   Devillers, L. and J.-C. Martin, *Corpus émotionnels : de l'acquisition à la modélisation*, in *Systèmes*

d'interaction émotionnelle (Traité signal et image, IC2), C. Pelachaud, Editor. 2010, Hermès Science. pp. chap 3.

B5.   Doan, B. and J.-P. Sansonnet, *Apport du contexte de tâche dans la recherche d'information*, in *La recherche d'information en contexte. Outils et usages applicatifs*, L. Grivel, Editor. 2011, Hermès. pp. 63-95.

B6.   Garcia-Flores, J. and W. Turner, *Técnicas de ingeniería lingüística para el estudio de migraciones altamente calificadas: buscando biotecnólogos argentinos en internet*, in *Más allá de la fuga de cerebros. Tendencias en la movilidad y migración calificada de argentinos*, L. Luchilo, Editor. 2011, Eudeba. pp. 15-22.

B7.   Jacquet, C., Y. Bellik, and Y. Bourda, *Vers de nouveaux panneaux interactifs dans les gares et stations*, in *Interaction homme-machine dans les transports - information voyageur, personnalisation et assistance*, C. Kolski, Editor. 2010, Hermès Science. pp. 253-286.

B8.   Jacquet, C., Y. Bellik, and Y. Bourda, *Towards new interactive displays in stations and airports*, in *Human-computer interactions in transport*, C. Kolski, Editor. 2011, Wiley - ISTE. pp. 311-342.

B9.   Pruvost, G., T. Heinroth, Y. Bellik, and W. Minker, *User interaction adaptation within ambient environments*, in *Next generation intelligent environments, ambient adaptive systems*, T. Heinroth and W. Minker, Eds. 2011, Springer. pp. 153-194.

B10.   Ripoche, G. and J.-P. Sansonnet, *What can archives of online distributed collectives teach us about interaction?*, in *Logical proprieties of dialogue*, A. Trognon, et al., Eds. 2011, Presses Universitaires de Nancy. pp. 97-121.

B11.   Sansonnet, J.-P. and E. Adam, *SMA Systèmes Multi-agents JFSMA 11* 2011: CEPADUES Editions. 246p.

B12.   Sansonnet, J.-P., A. Braffort, J.-C. Martin, and C. Verrecchia, *Towards interactive wab-based signing avatars*, in *Gesture in embodied communication and human-computer interaction, LCNS/LNAI 5934*, S. Kopp and I. Wachsmuth, Eds. 2010, Springer. pp. 313-324.

B13.   Turner, W., S. Buisine, J. Ganascia, L. Eveque, K. Fouladi, and J. Marlier, *La conception innovante des objets à intelligence incorporée*, in *Technologies de l'information et intelligences collectives (Collection Systèmes d'information et organisations documentaires) . Chap. 6*, B. Juanals and J.M. Noyer, Eds. 2010, Hermès Science. pp. 20.

Conferences with proceedings and review committee

C1.   Ammi, M. and B. Katz. *Design of haptic stimuli for audio-haptic concurrent coupling*. in *IEEE International Symposium on Haptic Audio-Visual Environments and Games*. 2011. Hebei, China. 74-80.

C2.   Asfari, O., B. Doan, Y. Bourda, and J.-P. Sansonnet. *Improving user query processing based on user profile and task context*. in *International Conference on Semantic Web Services*. 2010. Las Vegas, USA. 7p.

C3.   Asfari, O., B. Doan, Y. Bourda, and J.-P. Sansonnet. *A context-based model for web query reformulation*. in *International Conference on Knowledge Discovery and Information Retrieval*. 2010. Valencia, Spain. 6p.

C4.   Bonnet, D., M. Ammi, and J.-C. Martin. *Haptic communication of emotions through 3D mouvements*. in *IEEE International Symposium on Haptic Audio-Visual Environments and Games*. 2011. Hebei, China. 81-87.

C5.   Bouchara, T., B. Katz, C. Jacquemin, and C. Guastavino. *Audio-visual renderings for multimedia navigation*. in *International Conference on Auditory Display*. 2010. Washington, D.C., USA. 245-252.

C6.   Bouchet, F. and J.-P. Sansonnet. *Un cadre de modélisation des relations entre les réactions rationnelles et comportementales des agents assistants conversationnels*. in *Journées Francophones sur les Systèmes Multi-Agents*. 2010. Mahdia, Tunisia. 97-106.

C7.   Bouchet, F. and J.-P. Sansonnet. *Implementing personality adjectives as behavorial schemes*. in *IADIS International Conference on Interfaces and Human Computer Interaction*. 2010. Freiburg, Germany. 5p.

C8.   Bouchet, F. and J.-P. Sansonnet. *Classification of wordnet personality adjectives in the NEO PI-R taxonomy*. in *4ème Workshop sur les Agents Conversationnels Animés (WACA 2010)*. 2010. 83-90.

C9.   Bouchet, F. and J.-P. Sansonnet. *Influence of personality traits on the rational process of cognitive agents*. in *IEEE/WIC/ACM International Conference on Web Intelligence*. 2011. Lyon, France. 81-88.

C10.   Buisine, S., K. Fouladi, J. Nelson, and W. Turner. *Optimiser le processus d'innovation grâce aux traces informatiques d'usages*. in *Journées Francophones d'Ingénierie des Connaissances*. 2010. Nîmes, France. 145-156.

C11.   Caramiaux, B., S. Fdili Alaoui, T. Bouchara, G. Parseihian, and M. Rebillat. *Gestural auditory and visual interactive platform*. in *International Conference on Digital Audio Effects*. 2011. Paris, France. 4p.

C12.   Chaboissier, J., T. Isenberg, and F. Vernier. *Real time chess: lessons from a participatory design process for a collaborative multi-touch, multi-user game*. in *ACM International Conference on Interactive Tabletops and Surfaces*. 2011. Kobe, Japan: Jun Rekimoto and Hideki Koike and Kentaro Fukuchi and Yoshifumi Kitamura and Daniel Wigdor. 97-106.

C13. Courgeon, M., M. Amorim, C. Giroux, and J.-C. Martin. *Do users anticipate emotion dynamics in facial expressions of a virtual character?* in *Annual Conference on Computer Animation and Social Agents*. 2010. Saint Malo, France. 4p.

C14. Dahdouh, S., M. Dubois, E. Frenoux, and A. Osorio Sainz. *A 1D wavelet filtering for ultrasound images despeckling.* in *SPIE Medical Imaging*. 2010. San Diego, USA. 9p.

C15. Ding, H. and C. Jacquemin. *Palliating visual artifacts through audio rendering.* in *International Symposium on Smart Graphics*. 2011. Bremen, Germany. 4p.

C16. Ding, H., D. Schwarz, C. Jacquemin, and R. Cahen. *Spatial audio-graphic modeling for x3d.* in *International Conference on 3D Web Technology*. 2011. Paris, France. 4p.

C17. Dubois, M., H. Guillaume, E. Frenoux, and P. Tarroux. *Visual place recognition using Bayesian filtering with Markov chains.* in *European Symposium on Artificial Neural Networks, Computational Intelligence and Machine Learning*. 2011. Bruges, Belgium. 435-440.

C18. Eisert, P., C. Jacquemin, and A. Hilsmann. *Virtual jewel rendering for augmented reality environments.* in *International Conference on Image Processing*. 2010. Hong Kong, China. 1813 - 1816.

C19. Eyharabide, V., A. Amandi, M. Courgeon, C. Clavel, C. Zakaria, and J.-C. Martin. *An ontology for predicting students' emotions during a quiz. Comparison with self-reported emotions.* in *IEEE Symposium Series on Computational Intelligence*. 2011. Paris, France. 8p.

C20. Garcia-Flores, J. and W. Turner. *A nominal filter for Web search snippets: using the Web to identify members of Latin America's highly qualified diaspora.* in *Mexican International Conference on Artificial Intelligence*. 2011. Puebla, Mexico: IEEE. 45-50.

C21. Guillaume, H., M. Dubois, E. Frenoux, and P. Tarroux. *Temporal bag-of-words. A generative model for visual place recognition using temporal integration.* in *International Joint Conference on Computer Vision Theory and Applications*. 2011. Algarve, Portugal. 286-295.

C22. Hung, H. and C. Jacquemin. *Encounter (Resonances).* in *ACM International Conference on MultiMedia*. 2010. Firenze, Italy. 1421-1424.

C23. Jacquemin, C., W.-K. Chan, and M. Courgeon. *Bateau ivre: an artistic markerless outdoor mobile augmented reality installation on a riverboat.* in *ACM International Conference on MultiMedia*. 2010. Firenze, Italy. 10p.

C24. Jacquemin, C., G. Gagneré, and B. Lahoz. *Shedding light on shadow: Real-time interactive artworks based on cast shadows or silhouettes.* in *ACM International Conference on MultiMedia*. 2011. Scottsdale, Arizona, USA: ACM. 10p.

C25. Jacquemin, C. and B. Martin. *Interactive animation of a largescale crowd for art installations.* in *International Symposium on Electronic Art*. 2010. Ruhr, Germany. 5p.

C26. Miletto, E., M. Soares Pimenta, J.-P. Sansonnet, and F. Bouchet. *Social music making on the web with CODES.* in *Symposium On Applied Computing*. 2010. Sierre, Switzerland. 876-877.

C27. Mohamed, A., C. Jacquet, and Y. Bellik. *Diagnosis of ambient systems based on the modeling of effects.* in *The International Conference on Ambient Systems, Networks and Technologies*. 2010. Paris, France. 11p.

C28. Mohamed, A., C. Jacquet, and Y. Bellik. *Real-time diagnosis of ambient environments using a modeling of physical effects combined with temporal logic.* in *International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies*. 2011. Lisbon, Portugal. 7p.

C29. Osorio Sainz, A., J. Galan, J. Nauroy, P. Donars, J. Lobato, and I. Navarro. *Real time planning, guidance and validation of surgical acts using 3D segmentations, augmented reality projections and surgical tools video tracking.* in *SPIE Medical Imaging*. 2010. San Diego, USA. 11p.

C30. Osorio Sainz, A., J. Nauroy, S. Dahdouh, J. Biset, R. Boustani, and P. Donars. *A new PC based software to take and validate clinical decisions for colorectal cancer using metric 3D images segmentations.* in *European Congress of Radiology*. 2010. Viena, Austria. 1.

C31. Pelachaud, C., R. Gelin, J.-C. Martin, and Q. Le. *Expressive gestures displayed by a humanoid robot during a storytelling application.* in *International Symposium on New Frontiers in Human-Robot Interaction*. 2010. Leicester, UK. 4p.

C32. Sansonnet, J.-P. and Y. Bellik. *Expressing agents personality through ambient modalities.* in *4ème Workshop sur les Agents Conversationnels Animés (WACA 2010)*. 2010. 2p.

C33. Sansonnet, J.-P. and F. Bouchet. *Joint handling of rational and behavioral reactions in assistant conversational agents.* in *European Conference on Artificial Intelligence*. 2010. Lisbon, Spain. 2p.

C34. Sansonnet, J.-P. and F. Bouchet. *Expression of behaviors in assistant agents as influences on rational execution of plans.* in *International Conference on Intelligent Virtual Agents*. 2010. Philadelphia, USA. 7p.

C35. Sansonnet, J.-P. and F. Bouchet. *Extraction of agent psychological behaviors from glosses of wordnet personality adjectives.* in *European Workshop on Multi-Agent Systems*. 2010. Paris, France. 15p.

C36. Sansonnet, J.-P. and F. Bouchet. *Integrating psychological behaviors in the rational process of conversational Assistant Agents.* in *International FLAIRS Conference*. 2011. Palm Beach, Florida. 440-445.

C37. Sansonnet, J.-P. and F. Bouchet. *Personnification d'entités par Agents Conversationnels*. in *Conférence conjointe Modèles Formels pour l'Interaction et JFPDA MFI/JFPDA'11*. 2011. Rouen, France. 139-150.

C38. Sansonnet, J.-P., F. Bouchet, and W. Turner. *Personification of topics with conversational agents*. in *IADIS International Conference on Interfaces and Human Computer Interaction*. 2011. Roma, Italy: Katherine Blashki. 61-68.

C39. Schwarz, D., R. Cahen, F. Brument, H. Ding, and C. Jacquemin. *Sound level of detail in interactive audiographic 3D scenes*. in *International Computer Music Conference*. 2011. University of Huddersfield, UK: ICMC. 4p.

C40. Simard, J. and M. Ammi. *Gesture coordination in collaborative tasks through augmented haptic feedthrough*. in *Joint Virtual Reality Conference of EuroVR - EGVE - VEC*. 2010. Fellbach, Germany. 43-50.

C41. Simard, J., M. Ammi, and M. Auvray. *Study of synchronous and colocated collaboration for search tasks*. in *Joint Virtual Reality Conference of EuroVR - EGVE - VEC*. 2010. Fellbach, Germany. 51-54.

C42. Simard, J., M. Ammi, and M. Auvray. *Closely coupled collaboration for search tasks (Poster)*. in *ACM Symposium on Virtual Reality Software and Technology*. 2010. Hong Kong, China. 181-182.

C43. Simard, J., M. Ammi, and M. Auvray. *How to improve group performances on collocated synchronous manipulation tasks*. in *Joint Virtual Reality Conference of EuroVR - EGVE - VEC*. 2011. Nottingham, UK. 91-94.

C44. Tan, N., C. Clavel, M. Courgeon, and J.-C. Martin. *Postural expressions of action tendencies*. in *Workshop on on Social Signal Processing*. 2010. Firenze, Italy. 53-58.

C45. Tan, N., G. Pruvost, M. Courgeon, C. Clavel, Y. Bellik, and J.-C. Martin. *A location-aware virtual character in a smart room: effects on performance, presence and adaptivity*. in *International Conference on Intelligent User Interfaces*. 2011. Palo Alto, USA. 4p.

C46. Vernier, F. and C. Shen. *Multitouch Magic Fisheye : precise interaction with dense data on tabletop*. in *DEXIS*. 2011: with ITS 2011, the ACM International Conference on Interactive Tabletops and Surfaces. 4p.

Conferences without proceedings, workshops

D1. Caramiaux, B., S. Fdili Alaoui, T. Bouchara, G. Parseihian, and M. Rebillat. *Gestural auditory and visual interactive platform*. in *Versatile Sound Models for Interaction in Audio-Graphic Virtual Environments: Control of Audio-graphic Sound Synthesis Workshop*. 2011: IRCAM. 1.

D2. Courgeon, M., M. Rebillat, B. Katz, C. Clavel, and J.-C. Martin. *Life-sized audiovisual spatial social scenes with multiple characters: MARC & SMART-I2*. in *5ème Journées de l'Association Française de Réalité Virtuelle*. 2010.

D3. D'Alessandro, C., A. Quok, O. Deroo, D. Doukhan, R. Gelin, J.-C. Martin, C. Pelachaud, A. Rilliard, and S. Rosset. *Towards a storytelling humanoid robot*. in *AAAI 2010 Fall Symposium on Dialog With Robots*. 2010.

D4. Garcia-Flores, J., M. Deckert, W. Turner, and M. Hurault-Plantet. *The semantics of involvement: mining the web to locate biomedical expertise*. in *International Symposium on Semantic Mining in Biomedicine*. 2010. Hinxton, UK.

D5. Gueniat, F., C. Douay, L. Pastur, F. Lusseyran, M. Ammi, J. Falcou, and R. Montagne. *Fast FTLE computations ; Computations of Lagrangian Coherant Structures*. in *International Symposium Bifurcations and Instabilities in Fluid Dynamics*. 2011. 18/07 au 21/07. 00-00.

D6. Perret, J. and M. Ammi, *Minutes of the second meeting of the Haptics SIG*, in *Special Interest Group on Haptics (Haptics SIG)*2011, HDR during VRIC11, soutenue, le.

D7. Turner, W. and J. Flores. *Computer supporting diaspora knowledge networks*. in *Digital Methods and Migration Workshop*. 2010.

D8. Turner, W., J.-P. Sansonnet, and J. Garcia-Flores. *Réification de traces d'interactions de collectifs humains sous forme d'agent conversationnel*. in *Atelier IC 2011 Traces, traces numériques, connaissances et cognition - 22èmes Journées francophones d'Ingénierie des Connaissances*. 2011. 16p.

D9. Turner, W., J.-P. Sansonnet, and J. Garcia-Flores. *Le cadrage des pratiques interprétatives par les agents conversationnels (Short paper)*. in *Atelier IC 2011 Traces, traces numériques, connaissances et cognition - 22èmes Journées francophones d'Ingénierie des Connaissances*. 2011. 2p.

JEAN-CLAUDE MARTIN

Introduction

The group « Cognition Perception and Use » aims at exploring cognitive, perceptual and emotional processes in human agents and in computer agents. These processes are considered in different contexts such as spatial navigation, task-oriented interaction, problem solving and emotional situations. Experimental protocols are defined to assess the usability and the ergonomics of human-computer interaction in these domains.

The agents that are considered can be either humans, robots or virtual agents. They have a task to accomplish and they can behave individually or in collaboration. They are situated in real or virtual environments and are thus facing multifactorial and dynamic situations.

Research is conducted in two complementary directions. First, we model human and computer capacities supporting and coordinating cognitive, perceptive and emotional processes (e.g. interpretation, symbolic and sub-symbolic processing, reasoning, emotional appraisal ...). Second, we study the performance of participants when articulating these various processes in complex situations.

The expertise of the agents, possibly built across multiple repetition of the same task, is considered in the modeling of performance. The focus is on the impact of the situational context on the design of human-computer interaction.

In 2011, the topic « Virtual Agents and Emotions » moved from the AMI group to the CPU group to reflect the increasing links between this topic of research and Psychology (e.g. cognition and emotion, individual differences, nonverbal communication). Jean-Claude Martin is head of the CPU group since September 2011.

In order to address the above mentioned research goals, the CPU group is structured around four topics of research: "Perceptual Systems and Models", "Image, Language, Space", "Cognitive Ergonomics" and "Virtual Agents and Emotions". These four complementary topics of research enable to jointly 1) provide answers to key research questions in Psychology about cognition, perception and use ; 2) design and evaluate advanced interfaces for human-machine interaction. Each of these four topics considers cognition, perception and use, but in four different areas and from different perspectives.

These four complementary topics also correspond to specific collaborations about the design and evaluation of human-computer interaction with research conducted in other groups of LIMSI.

Research presentation

Topic 1: Perceptual Systems and Models

Ph. Tarroux, M. Auvray, M. Dubois, G. Jaber, A. Jauffret, I.K. Kueviakoe, J.-S. Liénard

Perception is viewed as the set of processes that lead to decide appropriate actions in a given context from a sensory signal. It is an essential cognitive ability of natural systems. Perception should be seen as an active process of transformation and selection of information. It can additionnaly be seen as the interaction with the world through attentional mechanisms and actions performed by a system with perceptual capacities. Understanding these processes is essential to build robots with autonomy and reasoning skills in uncertain and unknown environments.

Research of this theme are therefore part of a constructivist and interactionist view of cognition. Consequently, the models that we develop are tested on robots that allow a situated approach to cognition. These models heavily rely on proactive and dynamic perception by focusing on attentional processes and the acquisition of information about the world via actions through the notion of sensorimotor contingencies.

Two approaches of modeling have been explored. The first approach is based on the connectionist paradigm with the development of bioinspired models. The second approach uses the Bayesian paradigm to explore perceptual phenomena more broadly.

The first approach, issued from the thesis work of Herve Guillaume, continued during the thesis of Mathieu Dubois, concerns mainly semantic recognition of places by a robotic system. Place recognition is

essential for the consideration of context. Determining the context of a scene is important when one considers that it facilitates the identification of objects in the scene. Besides, knowing about context allows to simplify the features that must be retained for the identification of objects. It also becomes possible to use the conditional probability of finding an object in a specific place.

A bag-of-words (BoW) approach was used to discretize the visual vector characterizing the place. Our study focused primarily on the Gist descriptor proposed by Torralba (Torralba 2003), the CENTRIST descriptor (Wu et al. 2011) and the use of self-organizing maps (SOM) to perform this discretization. A first model based on the use of a naive Bayes classifier gives directly the probability of being in a place conditional on visual observations. A second model (Bayesian Filtering with Markov Chain: BFMC) incorporates the information contained in the transitions between images. Several image descriptors can be used to form the visual words characteristics. Both approaches are used with a temporal integration process in which several consecutive views are integrated to compute the answer of the system. We have shown that both of these descriptors provide classification results with scenes of the order or greater than the state of the art (Ullah 2007) on the database reference COLD developed by Ullah et al (Ullah 2007). Alternatively, as part of the thesis of Ahmad Hasasneh, we have shown that, using small images of the scene, always from the same database, deep networks (deep Belief networks: DBN) followed by a linear classification step also give satisfactory results.
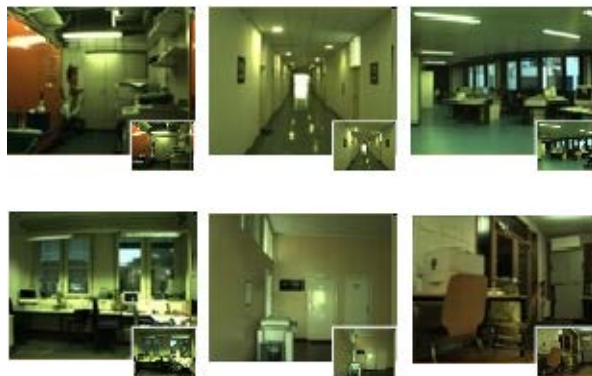
Samples of the COLD database used for testing our Semantic PLace Recognition approaches. The corresponding 32x24 tiny images displayed bottom right show that, despite the size reduction, these small images remain fully recognizable.

In the context of the Digiteo project Roboteo-Handler, the research grant obtained in collaboration with the ACCIS group of IEF (Institut d'Electronique Fondamentale) (Ignace Kueviakoe) allowed us to implement on a Robulab-10 robot a 3D-image capture system with a kinect camera. The ability of this system to improve the visual recognition of places visited by the robot is under investigation. The thesis project is currently moving towards the implementation of approaches to localization using interval analysis (Seignez 2005) which has the advantage over bayesian approaches to SLAM to produce bounded errors.

The Digiteo project Auto-Eval, filed jointly with the ENSEA ETIS (Cergy-Pontoise) laboratory, aims to translate into Bayesian models the models of positioning, navigation and planning developed at ETIS (Adrien Jauffret thesis). A first step being published consists in the translation into a Bayesian model and its implementation on the Robulab-10 basis of a place cells model (Cuperlier et al. 2007) previously implemented using bioinspired methods. Eventually the project aims at developing metacontrollers allowing an autonomous robot to identify situations in which it deviates from its task (for example if its location becomes invalid after a long time of navigation). This observation must be able to identify the sensor in error or induce a learning process of the new conditions. The notion of anticipation and the difference between anticipation and actual perception will be the key driver of these mechanisms.

The robot (Robulab 10 from Robosoft) used at LIMSI for place and object recognition and autonomous navigation experiments

Most of the methods used so far are based on sensor data assumed to be independent and identically distributed (iid assumption). This assumption is, in robotics, far from being verified. The data are actually acquired by the robot during its exploration, often online and actively. The incremental acquisition of data, sometimes over long periods of time, raises questions about the notion of concept drift. Concerning for example the problem of semantic place recognition, the current approach distinguishes three situations of illumination (sunny, cloudy and night) considering statistically stationary local distribution rather than a global non-stationary one. G. Jaber's thesis developed in collaboration with the computer laboratory of the Institut National Agronomique (INA), aims at studying this kind of situation where the iid assumption is no longer valid. A first modeling work was completed and published (Jaber et al. 2011). This work is ongoing now through an internship of G. Jaber in the laboratory of Yann LeCun (The Courant Institute of Mathematical Sciences, New York University).

Scene analysis does not apply only to scenes of the visual world. The auditory modality can also locate and separate sound sources in our environment (ASA, Auditory Scene Analysis). This is a crucial problem for the human listener experiencing hearing impairment, as evidenced by the classic cocktail party effect. It is also a stumbling block for automatic processing of speech, which so far has avoided the problem by doing a close miking. Thanks to an "Action Incitative" of the laboratory, in cooperation with Claude Barras (TLP group), we made progress on multipitch detection, a major step towards voice separation. Our HSP algorithm, based on the combined use of several families of spectral combs (presented at ASA POMA 08), can detect the presence of one or more voices in a single-channel mixing. The thesis of Francois Signol defended in December 2009 concerned the rationale and evaluation of the algorithm. We also found that when two voices overlap for a certain duration, the actual duration of superposition of voiced segments only is much shorter than previously thought (about 25% only, ICPhS 2011 communication). Thus the high performance of HSP in multiple voicing detection may help to precisely locate the mono-voiced segments (the most numerous: 50%) and use them as islands of reliability for various automatic processings (recognition of speech, speaker, and diarization). We continue on this track with new databases.

In parallel, we are reconsidering the bases of the Vocal Effort problem by formulating it in the framework of the situated and interactive oral communication (Pevoc 2011). During a discussion involving several

talkers each one is required to intervene with some voice strength - from very low to very high - reflecting his/her position in relation to others in terms of physical distance, ambient noise, dominance, or emotion. But increasing the intensity of voice results in considerable variations in the acoustic structures of signal. These variations are clearly perceived and used by any listener but have been little studied so far, despite the fact that they greatly alter the performance of the automatic processing techniques. We continue this study as part of a new "Action Incitative" with Claude Barras in connection with other researchers at LIMSI.
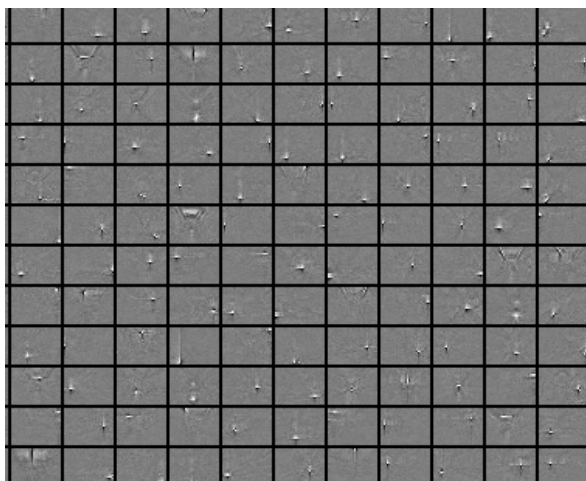
A sample of the 32x24 features obtained by training a RBM layer on tiny-COLD images. Most of the obtained features are localized edges and corners leading to a sparse representation of the data.

Topic 2: Image, Language, Space

M. Denis, M.-P. Daniel, M. Auvray

The focus of this topic of research is on the interactions between image, language and space. These topics were adressed in three recent projects which provide both theoretical and applied contributions.

Navigation assisted by artificial vision and global navigation satellite system: An assistive device for blind and low-vision users. The NAVIG project, funded by the ANR, aims at designing a navigation aid device involving geolocalisation, artificial vision and an auditory rendering of the information. The research consortium includes three CNRS-supported laboratories specialized in interaction and disability (IRIT-IHCS, Toulouse), human and artificial vision (CERCO, Toulouse), and human-machine communication (LIMSI-CNRS, Orsay), two companies active in the fields of artificial vision (SpikeNet Technology) and geolocalization (NAVOCAP), and an institute of special education for visually-impaired persons (INJA-CESDV). At LIMSI, two teams are involved and cooperate on the project. One team coordinated by B. Katz (Group AA) handles the acoustic design of the device. The other team is coordinated by M. Denis and M. Auvray. It handles the experimental and ergonomics side of the study. For the latter part of the project, several research axes have been conducted in order to determine the best way to present information to blind persons. The first axis investigated the mechanisms of representation of space that are specific to blind people. We designed a set of experiments using a virtual auditory environment with binaural guidance. It was used to investigate if blind travelers, who are given an ongoing access to distal cues in a navigation task, show a better understanding of the spatial relations among the elements of the environment compared to blind travelers that do not have such information. A second axis aimed at specifying blind people's needs in terms of displacements according to a participatory design. It allowed us to link their specific needs in terms of information to their mode of preparation for a journey. Several experimental protocols were subsequently designed to investigate whether these needs can be satisfied by the different prototypes.

The NAVIG prototype including a GPS receiver, a stereoscopic camera, and a head motion tracking device mounted on a helmet. Microphone and headphones are used to transmit speech and audio information.

Spatial representations in a life-span perspective: Cognitive and developmental factors. SPALIFE, an ANR-funded project, proposes a life-span perspective in the study of the cognitive processes underlying human spatial representations in wayfinding situations. In addition to M.-P. Daniel and M. Denis at LIMSI, two CNRS partner teams are involved: the Laboratoire de Psychologie et de Neurosciences Cognitives (Paris Descartes) and the Laboratoire Structures Formelles du Langage (Paris VIII). The aim of the project is threefold: a) to study the nature of spatial representations; b) to examine the cognitive constraints on the construction of these representations, with particular attention to working memory; c) to assess how these representations evolve with age from a life-span perspective that compares young children, young adults, and older adults. Two main questions were examined: a) What are the effects of the source of acquisition of spatial knowledge (navigation vs. video presentation) on the resulting mental representation?; b) Do spatial representations evolve with age, and how? In a first experiment, we examined the effect of informational richness of two routes in an urban environment on their memorization. Sixty participants were asked to describe verbally the route they had just travelled. The results showed that although both routes were of similar length and structural complexity, the route with the larger number of landmarks resulted in significantly longer descriptions. Two recognition tests – one consisting in identifying photographs of places along the route vs. distractors, and the other consisting in identifying the correct ordering of two such places – resulted in similar high performance for both routes. In a further experiment, the effect of route learning through actual navigation or from attending a video of the route was investigated. New participants were presented with a video of a route, then submitted to the same recognition tests. Interestingly, both learning conditions resulted in very similar scores on the recognition tests, but recognition was consistently slower in the video condition. Our data attest to the fact that video required more cognitive effort than navigation, especially with older participants. There was a clear impact of age on route memorization, with older participants having lower performance and longer response times in both recognition tasks.

Order recognition task: "Which of these pictures did you encounter first along the route?"

Reasoning about spatial relations encoded through descriptive language. In the context of the DESMI project, our team (M. Denis and M.-P. Daniel) are collaborating with two other major European labs specialized in the contribution of spatial language to the construction of spatial knowledge (University of Nicosia, Cyprus, and University of Padova, Italy). We have conducted a series of experiments to investigate how spatial information described in narratives is organized in memory. Participants read short stories describing themselves at remote settings and memorized the locations of objects in them. Subsequently, they physically rotated to the left or right to match (or mismatch) a change of orientation described in the narrative and then pointed towards memorized objects from imagined perspectives. In all experiments, performance was faster and more accurate when participants pointed to objects from the imagined perspective that was aligned with the initial orientation described in the narrative than any other orientation. Importantly, pointing performance was comparable from perspectives that were aligned vs. counter-aligned with their actual facing direction at test. These findings suggest that (1) participants maintained spatial information in memory from a preferred direction that was determined by the initial orientation introduced in the narrative, and (2) they did not update this initial spatial memory when physically rotating. Overall, our results suggest that no sensorimotor influences take place when reasoning about remote environments described in texts. The implications of these findings for theories of spatial memory are discussed in connection with findings from spatial updating studies showing that sensorimotor effects are tenable under certain conditions of remote testing with visually-encoded scenes.

Topic 3: Cognitive Ergonomics: Anthropocentric Design of Multimodal and Collaborative Work Technologies

F. Darses, *M.P. Daniel, C. Clavel, A. Mayeur, L. Brunet, S. Carminati*

The research studies under this topic seek to model the cognitive activities of individuals in situations involving the use of work-related devices featuring a strong multimodal component and, in some cases, collaborative work conditions. We seek to determine the extent to which the user's expertise can be enhanced, or altered, depending on the multimodal properties of the considered technologies. We also seek to assess the impact of collaboration on task performance.

The research is performed in accordance with the principles of ergonomic psychology: the natural cognitive processes of individuals interacting with complex computerized systems are studied in "situated" contexts. We seek to model expertise, i.e., the cognitive skills acquired by individuals through repeated practice, on which performance is based. The notion of "performance" makes it necessary to take into account the multifactorial nature of *real* technology-usage situations.

Following this "situated cognition" framework, two complementary approaches are used. *In-situ* data collection allows the researcher to describe the multifactorial characteristics of situations: uncertainty concerning external constraints and available resources, the possible occurrence of unexpected and unplanned interactions with human or artificial agents, the necessary modification of previously established strategies to formulate a new procedure, etc... These *in-situ* analyses allow us to identify key factors, which will subsequently be the object of laboratory experiments involving activity scenarios based on realistic situations.

Distance collaboration for creative design. The goal of this research is to study and model the use of presential, or—increasingly often—remote, collaborative systems. This research was developed within the framework of the ANR CoCrea (programme Création) project (2009-2011), which concerns collaborative practices in architectural creativity. Two collaboration modes were examined: (i) "co-localised" versus (ii) "remote" actors communicating via new information technologies. Our goal was threefold: to describe these collaborative practices as they currently exist; to describe their implications in terms of multimodal activity; to specify how this multimodal activity must be preserved in collaborative systems dedicated to creativity. The apparatus used in these experiments is a "digital collaborative studio" (provided by partners of the consortium) that recreates natural design conditions by coupling a hand-sketching software with a videoconference system. Our study showed that this system did not alter multimodal performance compared to a colocalized collaboration situation. We have also identified some of the conditions that must be fulfilled in order to ensure effective collaborations.

Collaboration in virtual environments (collaboration with VENISE). A current limitation of interactive systems for the manipulation of 3D objects in virtual and immersive environments stems from the fact that these systems are focused on individual circumstances, and that they do not take into account the benefits of collaboration that characterize most real industrial tasks. The goal of this research, which pertains to an ongoing collaboration with the VENISE group, is the evaluation of a multimodal and collaborative

demonstrator, which allows two users to evolve within the same immersive environment (EVE). The collaborative task, which was chosen for this research, involves the coordinated manipulation of containers using a virtual forklift truck. An immersive, co-localized scenario involving a truck driver and his/her assistant has been written, and exploratory experimental studies are underway. This will allow us to measure the performance of the driver-assistant duo in relation to the collaborative strategies used to manipulate virtual objects, and the technical characteristics of the immersive system.

User-centered evaluation of virtual environments (collaboration with VENISE). This research seeks to promote user-centered analyses and evaluations of interactive systems in a virtual environment. Studies concerning the ergonomy, and the use, of technologies developed with the VENISE team are currently being performed to evaluate the qualities of systems, in particular, their "degree" of immersion, presence, and realism. A first study centered on the evaluation of the proprioceptive control of virtual navigation has led us to question the relevance of the "performance" criterion for measuring the realism of immersive interactive systems.

Design and evaluation of haptic interactions for pedestrian navigation in urban environments (collaboration with CEA-LIST]. This research topic was explored in L. Brunet's PhD work (which was performed in the context of the ANR Tictact project at CEA, and under the supervision of C. Mégard, in the LISA/LIST laboratory). It relates to the design and to the evaluation of urban-navigation aids for pedestrians using haptic interactions. The analysis of the mobility needs, and of the resources currently used by pedestrians (visual interactions using medias such as maps, smartphones, etc…), has shed light on the factors underlying cognitive navigation activities: key phases of the displacement, information sources used, forms of expert knowledge of the network and of the itinerary, pace. At the end of this phase, we were able to identify cognitive activities leading to the acquisition of information, and interactions that might be used in the haptic modality: guiding, warning, and reassurance. A prototype concept involving a bracelet linked to a smartphone via a Bluetooth connection, is currently being studied.

Evaluation of information-seeking behaviors in pedestrians navigating in an urban environnement (since Febuary 2012, in collaboration with Paris-Descartes University). The context of this research is the study of cognitive processes involved during the formation, memorization, and use of spatial representations for navigation. Initial experiments (performed in the framework of the ANR « Spalife » project, in collaboration with Paris-Descartes University, and with the help of S. Carminati, Master student in Ergonomics at Paris-Sud University) seek to improve our understanding of the interactions between spatial-information aids and actual information-seeking behaviors in the field. In particular, we are interested in the influence of the format of the source, which is used to form a mental representation of an itinerary, on the success of the navigation. The goal is to improve the design of navigation aids. One experiment, which is currently underway in the town of Boulogne, examines the influence of the characteristics of two information sources (verbal description compared to a map featuring street names or landmarks) on itinerary-preparation behaviors. Recordings obtained using an eye-tracking device, which reflect visual-search behavior in the field, and indices such as the number of stops, errors, hesitations, etc… are currently being analyzed. Post-experiment interviews will additionally allow us to ask participants about their search-for-direction behavior during the experiment.

Topic 4: Virtual Agents and Emotions

J.-C. Martin, C. Clavel, M. Courgeon, V. Eyharabide, C. Zakaria, T. Giraud, L. Philip, N. Tan

Emotion is key to human-human social interaction. An emotion can be seen as an episode of interrelated, synchronized changes in five components in response to an event of major significance to the organism (Scherer 2000). These five components are: the cognitive processing, the subjective feeling, the action tendencies, the physiological changes, and the motor expression across multiple modalities. In their survey, Gross and Barrett (2011) arrange perspectives on emotion along a continuum including the following approaches to emotion: basic emotions, appraisal, psychological construction, and social construction.

Current human-computer interfaces are limited in the way they manage these different theories of emotions and the multimodality of emotional expressions. *Affective Computing* is defined as the study and development of systems and devices that can recognize, interpret, process, and simulate human affects (Picard 1997). Virtual agents that simulate and express emotions have recently received a growing interest in pluri-disciplinary research (e.g. HUMAINE, a dedicated international association was created in 2007 ; a new IEEE journal called Transactions on Affective Computing was launched in 2010). Emotions and their expressions by virtual characters are two important issues for future affective human-machine interfaces. Recent advances in psychology of emotions as well as recent progress in computer graphics allow us to

animate virtual characters that are capable of expressing emotions in a realistic way through various modalities. Existing virtual agent systems are nevertheless limited in terms of underlying emotional models, visual realism, real-time interaction capabilities and the consideration of several modalities.

The topic of research on "Virtual Agents and Emotions" aims at defining and evaluating computational models of non-verbal expressions of emotions. Such models are required for designing intuitive interactive virtual characters that need to consider in real-time the current situation to decide which emotion to express and how to express it in non-verbal modalities. These interfaces were observed to be promising in several application areas such as e-learning, edutainment, assistance, remediation but also experimental studies of human perception. Among the different approaches to emotion that we listed above, we focus on the appraisal approach since it is relevant for situated human-computer interaction. Our interest in affects goes beyond basic emotions and includes the superposition of several emotions, complex emotions, personality and interpersonal attitudes.

This topic is quite relevant to the CPU group thanks to its strong links between Psychology and Human-Computer interfaces. We thus adopt an experimental approach and ground our work on multimodal corpora. For example, we defined symbolic schemes for coding postures within the project ANR OTIM (tools for computational processing of multimodal data) and for coding social interaction (project FUI HD3D2 in collaboration with several animation studios).

The originality of our work lies in our focus on virtual agents that interact in real time with users, are realistic in terms of appearance and behaviors, combine several nonverbal modalities and devices (facial expressions, postures, haptics, physiological measures, 3D, Virtual Reality), are inspired from studies in Psychology and Multimodal corpora, and are systematically evaluated using an experimental approach.

This topic of research is structured in the following directions of research: facial expressions of emotions, bodily expressions of emotions, and their applications.

Facial expressions of emotions. We explore how virtual agents are capable of expressing emotions through facial expressions while interacting with the user. This question raises several issues: How can we design computational models of emotions inspired by the different approaches to emotion in Psychology? What is the level of visual realism required for the agent to express emotions? How can we enable real-time interaction with a virtual agent? How can we evaluate the impact on the user of the emotions expressed by the virtual agent? Our work focuses on computational modeling of emotions and is inspired by psychological theories of emotion and emotional facial expressions by a realistic virtual character. Our main goal is to contribute to the improvement of the interaction between a user and an expressive virtual agent. For this purpose, our research highlights the pros and cons of different approaches to emotions and different computer graphics techniques. We worked in two complementary directions during the PhD thesis of Matthieu Courgeon. First, we explored different approaches to emotions (categorical, dimensional, cognitive, and social). For each of these approaches, a computational model has been designed together with a method for real-time facial animation. Our second line of research focuses on the contribution of visual realism and the level of graphic detail of the expressiveness of the agent. This axis is complementary to the first one, because a greater level of visual detail may contribute to a better expression of the complexity of the underlying computational model of emotion. Our work along these two lines was evaluated by several perceptual studies. The software modules that we have designed are integrated in the platform MARC (Multimodal Affective and Reactive Characters) (Courgeon 2011).

Bodily interaction. Posture is less explored than other modalities, such as facial expressions. The postural expressions of others have a huge impact on how we conduct an interaction. Devices and interfaces for enabling full-body interaction are available (e.g., Kinect and full-body avatars), but systems still lack computational models relating these modalities to spatial and emotional communicative functions. The goal of Ning Tan's thesis was to lay the foundations for computational models that enable better use of posture in human-computer interaction. This necessitates addressing several research questions: How can we represent postures used in interpersonal communication? How can these representations inform the design of virtual characters? What are the requirements of a model of postural interaction for application to interactive virtual characters? How can this model be applied in different spatial and social contexts? We defined a coding scheme for the manual annotation of posture at several levels of abstraction and for different body parts. These representations were used for analyzing the spatial and temporal relations between postures displayed by two human interlocutors during spontaneous conversations in a video corpus. Next, representations were used to inform the design of postural expressions displayed by virtual characters. For studying postural expressions, we selected one promising, relevant component of emotions: the action tendency. Animations of bodily expressions of action tendencies were designed and evaluated showing their relevance of the body

modality for expressing this component of emotions. Finally, postural expressions were designed for a virtual character used in an ambient interaction system. They were used to help users locate real objects in Limsi's intelligent room (the iRoom developed by Bellik and Pruvost). The impact of these bodily expressions on the user's performance, subjective perception and behavior was evaluated.

Research domains. Our research is used in several domains that involve different theories and application areas such as social disorders, therapy, learning, games and experimental studies about human perception and cognition.

We collaborate with specialists in *autism* (Ouriel Grynszpan & Jacqueline Nadel, UPMC) on the use of virtual characters for evaluating perception of emotions by autistic users (Grant from La Fondation de France and La Fondation Adrienne et Pierre Sommer) (Grynszpan et al. 2011). The MARC platform was also used in collaboration with the University of Tampere to study *social phobia* during real-time interaction with a virtual agent (Vanhala et al. 2012).

In terms of multimodality, we conducted several studies about the perception of congruent and incongruent expressions of emotions in facial expressions, postures and spoken utterances (ANR Affective Avatar project). Our results are in line with other studies in Neuroscience which observe that, in incongruent combinations of facial and bodily expressions of emotions, people report the arousal that is expressed by the posture, while they report the category of emotion that is expressed by the face.

E-learning is a key application domain for exploring emotions and for using virtual agents as pedagogical agents or virtual peers (e.g. the virtual agent represents a student). Indeed, emotions of students are observed to have an impact on learning outcomes. We applied our approach to the learning of the Java programming language (Eyharabide et al. 2010). We collected a video corpus of students interacting with a quizz intended to elicit emotions. An ontology was designed to predict student's emotions during this quizz.

We also collaborated with artists. Our expressive virtual character was used to represent the emotion detected in the movements of a dancer (ANR project CARE). The artist Pascale Barret used MARC and its real-time interaction expressive capabilities in her performance "Beautiful Beasts" (http://www.pascalebarret.com/).

Collaborations with the other groups of LIMSI. This topic of research works in collaboration with the other groups of the department. The MARC platform was integrated in the EVE virtual environment of the VENISE group (Vézien, Bourdot) and the Smart-I2 platform of the AA group (Katz) so as to be able to compare different rendering capabilities. A collaboration is also set-up with the AMI group in terms of personality of virtual agents (Sansonnet within the ACAI funded by CNRS STIC-AmSud program) and expressions of emotions in the haptic modality (Ammi). The ANR project ARMEN in collaboration with the TLP group (Devillers) involves a collaboration with the CPU group (design and experiment using the MARC virtual agent for assistance to elderly people). Audio-visual expressivity is key to several collaborations with the AA group (d'Alessandro, Rilliard) within the ANR GV-LEX project (corpus-based approach to postural expressions of emotion in the NAO robot), FUI ADN TR (digital doubles) and ANR PADE (corpus of facial expressions of emotions during interaction with a virtual agent).

Future directions. Our previous work on posture is being extended by considering individual differences and motion-capture techniques (project ANR INGREDIBLE and PhD thesis of Tom Giraud co-directed with Brice Isableu from the UFR Sciences and Techniques of the Physical and Sporting Activities (STAPS). Individual differences and personality will also be investigated in the ANR project MOCA in which we will design and evaluate a personality model for virtual agents and robots that has to match with user's personality. The Nao robot is being explored for its capabilities to express emotion using postures and be used for coaching.

Regulation is another important capacity related to emotion. In the ANR COMPARSE project, we will assess the impact of a feedback provided by a virtual character on multiple tasks and its impact on regulation processes. We will also extend our investigations of social disorders to Schizophrenia (collaboration with the hospital from Le Chesnay). Regulation and feedback are also central to the INTELLILANGUE project where they are applied to language learning using a virtual agent. They are also used in a recent experiment using our MARC agent as a virtual peer for teaching Java programming concepts.

Integration of several MARC expressive virtual characters (Courgeon, Martin, Jacquemin) in the immersive system EVE (P. Bourdot, J.-M.Vézien)

Highlights

- Collaboration with MIT Media Lab (J.-C. Martin & M. Courgeon)
- Integration of the MARC virtual characters in the virtual reality systems EVE (Venise) and Smart-I2 (AA)
- Co-organization of ACII 2011 conference (4th International Conference on Affective Computing and Intelligent Interaction) in Memphis (J.-C. Martin): edition of the proceedings by Springer
- Guest editor of a special issue of the journal ACM Transactions on Interactive Intelligent Systems (TiiS) on the topic "Affective Computing"

Staff

Permanent Staff

Firstname	Lastname	Type of position	Employer	HDR	Arrival date	Departure date
Malika	Auvray	CR	CNRS			
Sylvain	Caillou	Res. Eng.	CNRS			
Céline	Clavel	Ass. Prof.	U-PSud		Hired as of 01/09/2011	
Marie-Paule	Daniel	Ass. Prof.	U-PSud			
Françoise	Darses	Prof.	U-PSud	HDR		Left on 31/05/2011
Michel	Denis	DR (emeritus)	CNRS	HDR		
Jean-Sylvain	Liénard	DR (emeritus)	CNRS	HDR		
Jean-Claude	Martin	Prof.	U-PSud	HDR		
Philippe	Tarroux	Prof.	ENS Ulm	HDR		

PhD Students

Firstname	Lastname	Graduate school	University	Type of support	Start date	Date of defense
Sarwan	Abbasi	EDIPS	U-PSud	Pakistan PhD grant	01/12/2006	26/11/2010
Lucie	Brunet	SSMMH	U-PSud	CDD CEA	01/10/2011	
Matthieu	Courgeon	EDIPS	U-PSud	MNRT PhD grant	01/10/2008	21/11/2011
Mathieu	Dubois	EDIPS	U-PSud	MNRT PhD grant	01/10/2007	20/02/2012
Tom	Giraud	EDIPS	U-PSud	U-PSud PhD grant	01/10/2011	

Ghazal	Jaber	EDIPS	U-PSud	U-PSud PhD grant	01/10/2010	
Kangni	Kueviakoe	EDIPS	U-PSud	CDD CNRS DIGITEO	01/10/2010	
Léonor	Philip	SSMMH	U-PSud	CDD CNRS ANR COMPARSE	01/02/2012	
Ning	Tan	EDIPS	U-PSud	CDD CNRS ATRACO	01/12/2008	31/01/2012

Non permanent staff

Firstname	Lastname	Type of position	Employer	Arrival date	Departure date
Matthieu	Courgeon	Research Eng.	CNRS	01/12/2011	30/09/2012
Cédric	Coussinet	Research Eng.	CNRS	01/08/2009	30/06/2012
Françoise	Darses	External collaborator	IRBA	01/10/2008	31/05/2011
Patricia	Fleury-Chenu	CDD	CNRS	01/01/2010	31/03/2010
Mathieu	Gallay	Post-Doc	CNRS	01/09/2009	31/08/2011
Anaïs	Mayeur	Post-Doc	CNRS	01/02/2010	30/06/2011
Célia	Mores	CDD	CNRS	01/04/2010	30/09/2010

Indicators of scientific notoriety

Prizes and awards

- M. Denis was made Chevalier de la Légion d'Honneur (2011)
- M. Denis is Honorary Life Member of the Executive Committee of the International Union of Psychological Science

Editorial board appointment

- F. Darses : Directrice associée de la revue Le Travail Humain (IF : 0,5)
- F. Darses : Directrice Exécutive de la revue Le Travail Humain (depuis novembre 2010)
- M. Denis is member of Editorial Boards: Journal of Mental Imagery, Psychological Research, L'Année Psychologique, Spatial Cognition and Computation
- M. Denis is Member of the Editorial Committee of the Dictionary of Eminent Social Scientists: Autobiographies (Mattei Dogan Foundation, 2010)
- J.-C. Martin is Editor in Chief of the Springer Journal on Multimodal Interfaces http://www.springer.com/computer/hci/journal/12193
- J.-C. Martin is Guest editor of a special issue of the journal ACM Transactions on Interactive Intelligent Systems (TiiS) on the topic "Affective Computing"
- J.-C. Martin is Editorial Review Board of the International Journal of Synthetic Emotions (IJSE)

Organization of international or national scientific events

Member of the scientific, technical program and/or organizational committees for international/national conferences or workshops

- F. Darses : ECSCW 11, European Conference on Computer-Supported Cooperative Work Aarhus University, DK, 24-28 September 2011
- F. Darses : CAAD Futures Conference, 4-8 July, Liège, Belgique
- F. Darses : COOP 2010, 9th International Conference on the Design of Cooperative Systems May 19-21, 2010, Carry-le-Rouet, Provence, France
- F. Darses : DCC10 FOURTH INTERNATIONAL CONFERENCE ON DESIGN COMPUTING AND COGNITION (DCC'10), 12–14 July 2010 University of Stuttgart, Stuttgart, Germany
- F. Darses : Responsable des symposium de la Conference EPIQUE 2011, Metz, 5-7 septembre 2011
- F. Darses : Co-organisatrice du colloque de Synthèse et Perspectives du GDR Psycho Ergo, Toulouse le Mirail, 4-6 avril 2011
- F. Darses : EPIQUE 2011, Conference en Psychologie Ergonomique, Metz, 5-7 septembre 2011
- M. Denis : Member of the Steering Committee of the Conference on Spatial Information Theory (COSIT)
- M. Denis : Member of the Scientific Committee of the International Conference on Spatial Cognition (Rome, 2012)
- M. Denis : Vice-President of the International Congress of Applied Psychology (ICAP) (Paris, 2014)
- J.C. Martin : Co-organizer of the ACII 2011 conference (4th International Conference on Affective Computing and Intelligent Interaction) in Memphis: edition of the proceedings by Springer

- J.C. Martin : Co-organization of WACI 2011 (Workshop on Affective Computational Intelligence), IEEE Symposium Series on Computational Intelligence - SSCI 2011, , April 11-15, 2011 - Paris
- J.C. Martin : Co-organization of the 3rd International Workshop on Affective Interaction in Natural Environments (AFFINE 2010), Satellite Workshop at ACM Multimedia 2010, 25-29 October 2010, Firenze, Italy
- J.C. Martin : Co-organization of the international workshop "Multimodal Corpora: Advances in Capturing, Coding and Analyzing Multimodality" with M. Kipp, J.-C. Martin, P. Paggio and D. Heylen ; held in conjunction with the 7th International Conference for Language Resources and Evaluation (LREC 2010), 18 May 2010, Malta
- J.C. Martin : Co-organization of the workshop on "Virtual Humans" held at the Journées de l'Association Française de Réalité Virtuelle (AFRV), 7 Decembre 2010, Orsay.

Invited lectures, talks or seminars

Invited workshop speaker

- Marie-Paule Daniel, Spatial representations in a life-span perspective : Navigation in the city", European Project « Spatial Memory for linguistically-encoded environments", Workshop on Spatial cognition, Cyprus 1-2 december 2011

Invited talk (national or international)

- Auvray, M. (2012). Cognition spatiale et substitution sensorielles. Seminar Interactions Situées, University Paris IV, 24 February, Paris France.
- Auvray, M. & Deroy, O. (2011). Understanding sensory substitution devices beyond the perceptual assumption. Neuroscience Seminar, 17 November 2011, Trinity College, Hartford, USA.
- Deroy, O., & Auvray, M. (2011). Synesthesia and parasitic qualia. Cognitive Science Seminar, CUNY, 11 November 2011, New York, USA.
- Auvray, M., & Deroy, O. (2011). Understanding sensory substitution devices beyond the perceptual assumption. Workshop Feelings, Perception, and Action, 6-7 October, ENS, Paris.
- Auvray, M., & Deroy, O. (2011). Integrating sensory substitution devices: An analogy with reading. Seminar of the Sensory Research Forum, Institute of Philosophy, 6 October, London, UK.
- Auvray, M. (2010). Perceptual interactions in a minimalist tactile environment. Seminar of the Department of Psychiatry and Psychotherapy, University of Cologne, 15 April, Cologne, Germany.
- Deroy, O., & Auvray, M. (2010). A new look on sensory extensions. Workshop on Sensory Substitution, Synaesthesia, Sensation, and Perception, Institute of Philosophy, 31 March, London, UK.
- Auvray, M. (2010). Cross-modal change blindness. Seminar of the Sensory Research Forum, Institute of Philosophy, 30 March, London, UK.M. Denis : Opening talk, Congress of the French Psychological Society (Université Charles-de-Gaulle, Villeneuve d'Ascq, 2010)
- J.C. Martin : Invited talk at CERV, Brest, 17 January 2012
- Martin, J.-C. (2012) "Interactions Homme-Machine et Emotions : Recherches sur les Personnages Virtuels Interactifs", Séminaire de l'UR CIAMS équipe CMP, 19 janvier 2012, Université Paris-Sud
- Martin, J.-C., Courgeon, M., Clavel, C., Zakaria, C. (2011) "Humains virtuels & Humains réels" Colloque international du CIREVE (Centre Interdisciplinaire de Réalité Virtuelle), "La réalité virtuelle au service de la recherche", 27 & 28 January Université de Caen
- Martin, J.-C. (2011) "Interaction affective et ambiante avec les agents virtuels MARC", Atelier "modélisation des imaginaires : corps augmenté, robots et avatars humanoïdes : altérité technologique", 5 & 6 octobre, Télécom Paris
- Martin, J.-C. (2010) "Virtual and Real Humans", invited talk at Human Centered Multimedia, Institute of Computer Science, 26 Octobre Augsburg, Germany
- Martin, J.-C., Courgeon, M., Tan, N., Clavel, C. (2010) "Facial and Postural Expression of Emotion in Virtual and Real Humans", Journée "LIMA Emotions", 25 novembre 2010, Lyon
- Martin, J.-C. (2010) "Agents Conversationnels Animés & Humains Virtuels", Journée scientifique Personnalité Numérique, 21 Juin, Bordeaux
- Martin, J.-C., Courgeon, M., Tan, N., Clavel, C., Zakaria, C., Eyharabide, V. "Avatars & Emotions", 40 ans de l'IUT d'Orsay

Tutorial at workshops or conferences or summer schools

- F. Darses : Introduction à l'école d'été du GDR Psycho Ergo, Le Croisic, juin 2010

Participation in expertise and administration of research

International or national scientific networking

International networks

- J.C. Martin : Elected member of the HUMAINE Executive Committee (relected in 2011 for 6 years)

National networks or working groups

- F. Darses : Directrice Adjointe du GdR n°3169 « psycho ergo » (psychologie ergonomique et ergonomie cognitive)2008-2011
- J.C. Martin : Member of the French working group GT Agents Conversationnels Animés (ACA) http://acai.lip6.fr/
- Ph. Tarroux is member of GDR Robotique

Participation in evaluation or expertise committees

National committees (CoNRS, CNU, CCSU…)

- J.C. Martin : CCSU Computer Science Univ. Orsay (vice-president since 2012)
- Ph. Tarroux : CCSU 27ème University Paris-Sud
- Ph. Tarroux : CCSU 61ème University Paris-Sud

Expert for scientific evaluation committees

- F. Darses : 2011 : Membre du comité d'évaluation du programme CONTINT-ANR
- M. Denis : President of an Evaluation Panel of the European Research Council (Advanced Grants, Panel SH4-B, "The Human Mind and its Complexity") (2008-2013)
- M. Denis : President of the International Evaluation Committee of the Faculty of Psychology of the Free University of Brussels (2011)
- M. Denis : Evaluation Committee of the Program "Retour Post-Doctorants" of the Agence Nationale de la Recherche (2010: Vice-President; 2011: President)
- M. Denis : President of the Committee of the Lifetime Career Award of the International Union of Psychological Science (2011-2012)
- J.C. Martin : Expertise de réponses à des appels d'offres ANR
- J.C. Martin : Expert hired three times by the European Commission for the evaluations of the IP projects Companions and LIREC
- Ph. Tarroux : Reviewer of project proposals for the ANR

Member of the administration or advisory board

- F. Darses : Member of « Conseil scientifique du Centre d'Etudes de l'Emploi » (as of 2011)
- J.C. Martin : Elected member of the executive board of the International Association HUMAINE on Emotion in Human-Computer Interaction http://emotion-research.net/ (re-elected in 2011 for 6 years)

Member of selection juries

- F. Darses : Univ Bretagne Sud (poste PR en Ergonomie) en 2010
- F. Darses : Univ Paris Sud (poste MC en Psychologie) en 2011
- F. Darses : Univ. Lille (poste MC en Ergonomie) en 2011
- J.C. Martin : President of the selection jury for UFR STAPS, Orsay, 2011
- J.C. Martin : Member of the selection jury, CERV-ENIB 2011
- Ph. Tarroux : Selection juries University Paris-Sud

Teaching activities and duties in relation to research

- F. Darses : Direction de la Spécialité Ergonomie, Ingénierie de la Santé et des Facteurs Humains du Master Biologie & Santé, UPS 11 (2010-11)
- J.C. Martin : Master of Computer Science of University Paris-Sud, speciality "Interaction", module on "Virtual Humans"
- Ph. Tarroux : Co-direction of the module « Robotics » of the Master of Science IAC, University Paris-Sud

Dissemination and vulgarization

- C. Clavel and J.C. Martin : Reportage « Les avatars sont partout! », Journal 20h TF1, 22 février 2010, 8.8 millions de spectateurs

Contracts

Contract table

Acronym	Funding agency/Partner	Program	Nature	Resp. for LIMSI	General coordinator	Starting date	Ending date	LIMSI share
AFFECTIVE AVATARS	ANR	RNTL	Research collab.	Devillers L.	Devillers L.	01/12/2007	31/03/2010	297704
ATRACO	EU		EU contract	Bellik Y.		01/02/2008	30/07/2011	361320
OTIM	ANR	Basic science	Research collab.	Martin J.-C.	Blache Ph. (LPL)	10/10/2008	30/06/2012	54916
	University of Cyprus		Research collab.	Denis M.	Avraamides M. (U. Cyprus)	01/12/2008	30/11/2012	6870
CoCREA	ANR	CREATION	Research collab.	Darses F.	Darses F.	15/12/2008	14/12/2011	205000
GV-Lex	ANR	CONTINT	Research collab.	D'Alessandro C.	Gelin R. (CEA)	15/12/2008	14/06/2012	202807
SpaLife	ANR	Basic science	Research collab.	Daniel M.-P.	Gyselinck V. (LPNCog)	01/10/2009	30/09/2012	82380
HD3D2	Région Ile de France	Competitiveness cluster	Research collab.	Martin J.-C.	N. Blandine	01/01/2010	30/06/2011	94584
	Digiteo	PhD grant	Research collab.	Tarroux Ph.	Tarroux Ph.	01/10/2010	30/09/2013	97200
AUTO EVAL	Digiteo	Projet Emergent	Research collab.	Tarroux Ph.	Gaussier Ph. (ETIS)	01/10/2010	30/09/2013	16000
STIC Amsud ACAI	CNRS	Programme STICAmSud	Research collab.	Martin J.-C.		01/01/2011	31/12/2012	10000
Nomoseed	OSEO	AIMA	Research collab.	Tarroux Ph.	Tarroux Ph.	21/01/2011	21/07/2012	30000
FRESCO	ANR	JCJC	Research collab.	Auvray M.	Auvray M.	01/10/2011	30/09/2014	169941

Scientific publications

Doctoral theses and HDR

T1. Abbasi, S., *Human-computer interaction in 3D object manipulation in virtual environments: a cognitive ergonomics contribution* 2010, thèse de l'Université Paris-Sud. Soutenue au LIMSI, Orsay, le 26 novembre 2010, 208 p.

T2. Courgeon, M., *MARC : Modèles Informatiques des Emotions et de leurs Expressions Faciales pour l'Interaction Homme-Machine Affective Temps Réel* 2011, thèse de l'Université Paris-Sud. Soutenue au LIMSI, Orsay, le 21 novembre 2011, 200 p.

Articles in peer reviewed scientific journals

A1. Afonso, A., A. Blum, B. Katz, P. Tarroux, G. Borst, and M. Denis, *Structural properties of spatial representations in blind people : scanning images constructed from haptic exploration or from locomotion in a 3-D audio virtual environment.* Memory & Cognition, 2010. **38**: pp.591-604.

A2. Auvray, M., A. Gallace, and C. Spence, *Tactile short term memory for stimuli presented on the fingertips and across the rest of the body surface.* Attention, Perception, & Psychophysics, 2011. **73** (4): pp.1227-1241.

A3. Auvray, M., T. Hoellinger, S. Hanneton, and A. Roby-Brami, *Perceptual weight judgments when viewing one's own and other's movements under minimalist conditions of visual presentation.* Perception, 2011. **40** (9): pp.1081-1103.

A4. Courgeon, M., C. Clavel, N. Tan, and J.-C. Martin, *Front view vs. side view of facial and postural expressions of emotions in a virtual character.* Journal Transactions on Edutainment (TOE), 2011. **VI**: pp.132-143.

A5. Grynszpan, O., J. Nadel, J. Constant, F. Le Barillier, N. Carbonell, J. Simonin, J.-C. Martin, and M. Courgeon, *A new virtual environment paradigm for high functioning autism intended to help attentional disengagement in a social context.* Journal of Physical Therapy Education, 2011. (25): pp.42-47.

A6. Grynszpan, O., J. Nadel, J.-C. Martin, O. Simonin, P. Bailleul, Y. Wang, D. Gepner, F. Le Barillier, and J. Constant, *Self-Monitoring of Gaze in High Functioning Autism.* Journal of Autism and Developmental Disorders, 2011. pp.1-9.

A7. Hanneton, S., M. Auvray, and B. Durette, *The Vibe: a versatile vision-to-audition sensory substitution device.* Applied Bionics and Biomechanics, 2010. **7** (4): pp.269-276.

A8.   Tan, N. and J.-C. Martin, *Review of ANVIL: annotation of video and language data 5.0.* Language Documentation & Conservation (LD&C), 2011. **5**: pp.88-94.

Books & chapters in books

B1.   Cabanac, G., M. Chevalier, C. Clavel, A. Ciaccia, C. Julien, G. Hubert, C. Soule-Dupuy, and A. Tricot, *Recherche d'information et modélisation usagers*, in *Recherche d'information contextuelle, assistée et personnalisée*, B. Patrice, Editor. 2011, Hermès. pp. 1-26.

B2.   Chung, P.-C., M.-J. Lesot, and J.-C. Martin, *Proceedings of the Workshop on Affective Computational Intelligence (IEEE WACI 2011)*. IEEE ed 2011: IEEE Symposium Series on Computational Intelligence. 89p.

B3.   Clavel, C. and F. Cuisinier, *Compréhension de textes littéraires et émotions chez l'enfant : Influence de l'identification de l'expérience émotionnelle du protagoniste sur la construction du sens du récit*, in *Identité et spécificités de la psychologie différentielle*, A. de Ribaupierre, et al., Eds. 2010, Presses Universitaires de Rennes. pp. 167 - 171.

B4.   Cuisinier, F., C. Clavel, M. de Rosnay, and F. Pons, *Emotional experiences at the elementary school: Theoretical and pragmatic issues*, in *Emotions in research and practice*, P. Francisco, M. de Rosnay, and P.-A. Doudin, Eds. 2010, Aalborg Universitetsforlag. pp. 175 - 202.

B5.   Cuisinier, F., J.-L. Mogenet, and C. Clavel, *Adaptation française de l'échelle de mesure de l'affectivité chez l'enfant « How I feel » : Validation des outils et interrogations sur le développement des traits*, in *Identité et spécificités de la psychologie différentielle*, A. de Ribaupierre, et al., Eds. 2010, Presses Universitaires de Rennes. pp. 183 - 189.

B6.   D'Mello, S., A. Graesser, B. Schuller, and J.-C. Martin, *Proceedings of the 4th International Conference Affective Computing and Intelligent Interaction (ACII 2011)*. Vol. Lecture Notes in Computer Science, Volume 6974-6975. 2011: Springer. 618p.

B7.   Douglas-Cowie, E., C. Cox, J.-C. Martin, L. Devillers, R. Cowie, I. Sneddon, M. McRorie, C. Pelachaud, C. Peters, O. Lowry, A. Batliner, and F. Hönig, *The HUMAINE database*, in *Emotion-oriented systems: the humaine handbook*, P. Petta, C. Pelachaud, and R. Cowie, Eds. 2011, Springer. pp. 243-286.

B8.   Martin, J.-C., L. Devillers, A. Raouzaiou, G. Caridakis, Z. Ruttkay, C. Pelachaud, M. Mancini, R. Niewiadomski, H. Pirker, B. Krenn, I. Poggi, E. Caldognetto, F. Cavicchio, G. Merola, A. Garcia Rojas, and F. Vexo, *Coordinating the generation of signs in multiple modalities in an affective agent*, in *Emotion-oriented systems: the humaine handbook*, P. Petta, C. Pelachaud, and R. Cowie, Eds. 2011, Springer. pp. 349-368.

Conferences with proceedings and review committee

C1.   Bonnet, D., M. Ammi, and J.-C. Martin. *Haptic communication of emotions through 3D mouvements*. in *IEEE International Symposium on Haptic Audio-Visual Environments and Games*. 2011. Hebei, China. 81-87.

C2.   Clavel, C., L. Devillers, and J.-C. Martin. *Combinaisons d'expressions vocales, faciales et posturales des émotions chez un agent animé : ce que perçoivent les utilisateurs*. in *4ème Workshop sur les Agents Conversationnels Animés (WACA 2010)*. 2010: Université Lille I. 8p.

C3.   Dubois, M., H. Guillaume, E. Frenoux, and P. Tarroux. *Visual place recognition using Bayesian filtering with Markov chains*. in *European Symposium on Artificial Neural Networks, Computational Intelligence and Machine Learning*. 2011. Bruges, Belgium. 435-440.

C4.   Elsen, C., F. Darses, and P. Leclercq. *An anthropo-based standpoint on mediating objects : evolution and extension of industrial design practices*. in *International Conference on Design, Computing and Cognition Proceeding*. 2010. Stuttgart, Germany. 20p.

C5.   Eyharabide, V., A. Amandi, M. Courgeon, C. Clavel, C. Zakaria, and J.-C. Martin. *An ontology for predicting students' emotions during a quiz. Comparison with self-reported emotions*. in *IEEE Symposium Series on Computational Intelligence*. 2011. Paris, France. 8p.

C6.   Forma, V., S. Hanneton, M. Auvray, A. Roby-Brami, and T. Hoellinger. *Ears on the hand: reaching 3D audio targets*. in *SKILLS*. 2011. Montpellier, France: B.G. Bardy, J. Lagarde and D. Mottet (Eds.). 26_1-26_4.

C7.   Guillaume, H., M. Dubois, E. Frenoux, and P. Tarroux. *Temporal bag-of-words. A generative model for visual place recognition using temporal integration*. in *International Joint Conference on Computer Vision Theory and Applications*. 2011. Algarve, Portugal. 286-295.

C8.   Jaber, G., A. Cornuéjols, and P. Tarroux. *Predicting Concept Changes using a Committee of Experts*. in *International Conference on Neural Information Processing*. 2011. Shangaï, China. 9p.

C9.   Jaques, P., R. Vicari, S. Pesty, and J.-C. Martin. *Evaluating a cognitive-based affective student model*. in *International Conference on Affective Computing and Intelligent Interaction*. 2011. Memphis, USA. 599-608.

C10.   Liénard, J.-S. *Vocal effort in situation*. in *Pan European Voice Conference*. 2011. Marseille, France. 163-164.

C11.   Liénard, J.-S., C. Barras, and F. Signol. *Time structure and detection of the multivoiced segments in mixed speech*. in *International Congress of Phonetic Sciences*. 2011. Hong Kong, China. 1234-1237.

C12.   Picinali, L., B. Katz, A. Afonso, and M. Denis. *Acquisition of spatial knowledge of architectural spaces via active and passive aural explorations by the blind*. in *Forum Acusticum*. 2011. Aalborg, Denmark. 1311-1316.

C13.   Signol, F., J.-S. Liénard, and C. Barras. *Influence de la décision voisé/non-voisé dans l'évaluation comparative d'algorithmes d'estimation de F0*. in *Journées d'Etude sur la Parole*. 2010. Mons, Belgique. 4p.

C14.   Simard, J., M. Ammi, and M. Auvray. *Study of synchronous and colocated collaboration for search tasks*. in *Joint Virtual Reality Conference of EuroVR - EGVE - VEC*. 2010. Fellbach, Germany. 51-54.

C15.   Simard, J., M. Ammi, and M. Auvray. *Closely coupled collaboration for search tasks (Poster)*. in *ACM Symposium on Virtual Reality Software and Technology*. 2010. Hong Kong, China. 181-182.

C16.   Simard, J., M. Ammi, and M. Auvray. *How to improve group performances on collocated synchronous manipulation tasks*. in *Joint Virtual Reality Conference of EuroVR - EGVE - VEC*. 2011. Nottingham, UK. 91-94.

C17.   Tan, N., C. Clavel, M. Courgeon, and J.-C. Martin. *Expressions posturales de tendances à l'action*. in *4ème Workshop sur les Agents Conversationnels Animés (WACA 2010)*. 2010: Université Lille I. 8p.

C18.   Tan, N., G. Pruvost, M. Courgeon, C. Clavel, Y. Bellik, and J.-C. Martin. *A location-aware virtual character in a smart room: effects on performance, presence and adaptivity*. in *International Conference on Intelligent User Interfaces*. 2011. Palo Alto, USA. 4p.

Conferences without proceedings, workshops

D1.   Auvray, M. *Percevoir des dispositifs de compensation : de la substitution sensorielle à l'extension sensorimotrice*. in *Phiteco 2010. Philosophie, Technologie, Cognition : Appropriation individuelle et adoption collective de l'innovation*. 2010.

D2.   Auvray, M. *Perceiving with compensatory devices: Quasi-vision or new sensory modality*. in *American Philosophical Association Pacific Division*. 2011. San Diego, USA.

D3.   Auvray, M. and O. Deroy. *Understanding sensory substitution devices beyond the perceptual assumption*. in *Workshop Feelings, Perception, and Action*. 2011: Institut Jean Nicod, ENS.

D4.   Auvray, M., A. Gallace, and C. Spence. *Cécité aux changements et multimodalité*. in *Congrès de la Société Française de Psychologie*. 2010. Lille, France.

D5.   Auvray, M., A. Gallace, and C. Spence. *Which frame of reference is adopted when interpreting tactile letters presented on the body surface?* in *12th European Workshop on Imagery and Cognition (EWIC 2010)*. 2010.

D6.   Avraamides, M., A. Galati, C. Meneghetti, F. Pazzaglia, and M. Denis. *Spatial reasoning about remote environments encoded through narratives*. in *Seventeenth Conference of the European Society for Cognitive Psychology (ESCOP 2011)*. 2011: European Society for Cognitive Psychology.

D7.   Courgeon, M. *MARC: Models and Tools for Real-Time Interaction with Affective and Realistic Virtual Characters*. in *4ème Workshop sur les Agents Conversationnels Animés (WACA 2010)*. 2010: Université Lille I.

D8.   Daniel, M.-P. *Producing route directions to be heard or to be read? Effects of modality (spoken versus written) and communicative purpose on spatial language*. in *12th European Workshop on Imagery and Cognition (EWIC 2010)*. 2010.

D9.   Daniel, M.-P. and M. Denis. *Navigation in the city*. in *Workshop on Spatial Cognition*. 2011: University of Cyprus.

D10.   Denis, M., S. Abbasi, and J.M. Burkhardt. *Spatial problem solving and visuo-spatial imagery*. in *12th European Workshop on Imagery and Cognition (EWIC 2010)*. 2010.

D11.   Denis, M., S. Abbasi, and J.M. Burkhardt. *Spatial problem solving in realand virtual environments*. in *27th International Congress of Applied Psychology*. 2010.

D12.   Denis, M., S. Abbasi, and J.M. Burkhardt. *Solving puzzles in real and virtual environments*. in *European Congress of Psychology*. 2011. Istanbul, Turkey.

D13.   Deroy, O. and M. Auvray. *A new look on sensory extensions*. in *Workshop on Sensory Substitution, Synaesthesia, Sensation, and Perception*. 2010: Institute of Philosophy.

D14.   Gallay, M., M. Denis, G. Parseihian, and M. Auvray. *Egocentric and allocentric reference frames in a virtual auditory environment: difference in navigation skills between blind and sighted individuals*. in *12th European Workshop on Imagery and Cognition (EWIC 2010)*. 2010.

PATRICK BOURDOT

Introduction

VENISE (Virtual ENvironment for Immersive Simulation and Experiments) is the research group of LIMSI-CNRS in Virtual and Augmented Reality (V&AR). Our research aims at developing methods and tools to make immersive and collaborative interactions more "natural" or more intuitive, either in virtual worlds or in virtual worlds coupled to the real one. We strive at making our models generic enough so that they apply to a large range of immersive environments, such as collaborative (RAVE, CAVE, Workbench …), individual (HMD, see-through …), or multi-sensorimotor (stereoscopic, 3D audio, haptic…). We develop and test the usefulness of our concepts in the context of different application areas.

The first research topic is the study of **interaction models in V&AR**. This topic covers several types of problems, from the design of interactive paradigms for dedicated tasks (control of virtual navigations, sensorimotor rendering…), up to the development of intelligent systems for the multimodal supervision of immersive interactions, for individualized or collaborative experiments, in Virtual or Mixed Reality. In this respect, the question of the task is omni-present, because we systematically need to justify the added value of V&AR with respect to the already prevalent HCI techniques. One bottle-neck of V&AR interactions is real-time processing, which consequently raises questions about **data models or simulations** dedicated to the target applications. This second research topic aims at studying means of creating of a continuum between the models underlying focused applications and the available platforms for the implementation of such applications in V&AR. We mainly work on three approaches, which are sometimes used concurrently within the same applicative field. The first one concerns the in-depth analysis of data structures (assumed to be massive and complex) to take full advantage of V&AR data rendering techniques. The second approach is interested in real-time algorithms to create realistic virtual simulations dedicated to V&AR. The third one is to develop specific models to better integrate a given application within a V&AR framework.

The research of the group is showcased in the development of several demonstrators, some being dedicated to ergonomics studies, others being more oriented towards the analysis of usage scenarios related to different application domains. Four classes of V&AR applications are studied: scientific applications (data exploration and simulation in Computer Fluid Dynamics and in Structural Biology), education of sciences (related to the simulation of gravitational phenomena and relativity), remote control of autonomous vehicles with an Augmented Virtuality approach, and finally Virtual Reality for Product Lifecycle Management.

In addition to the fundamental aspects of research on V&AR, part of our activity has been devoted to the completion of the specification and the construction of our large multi-sensorimotor and multiuser CAVE-like equipment, called EVE (Evolutionary Virtual Environment). Initiated in 2000, the first stage of this ambitious scientific equipment was installed at the end of 2009. Co-funded by CNRS, the RTRA Digiteo (SIMCoD project labelled in 2007), and currently by the Equipex French government program (DIGISCOPE project labelled in 2010), the EVE system consists in a rear-projected floor of 13 m², and three screens of nearly 5 meters high. A double-stereoscopy technology allows the management of an exact visual depth perception for two user groups, so as to study co-localized immersive collaboration. 3D audio renderings of high fidelity are also possible thanks to acoustic constraints enforced on the projectors and the hall that hosts this immersive system. Coupled with haptic devices the full setup is therefore a unique scientific tool for the study of multi-sensorimotor immersive interactions. Last but not least, the EVE system can morph into a number of geometric configurations, from a classic rectangular CAVE, to a large Wall, and may even be divided into two separate setups (a CAVE corner + Wall), making it possible to conduct two different experiments at the same time, and more importantly, to simulate distant immersive collaborations and to compare such interactive paradigms with those employed in co-localised situations (cf. double-stereoscopy).

At the European level, we are involved in EuroVR, the European Association of V&AR that exploits the outcomes of INTUITION (Network of Excellence on vIrtual reality aNd virTUal environments applIcatIONs for future workspaces) a former NoE of the FP6 EC program (IST) within which we coordinated the activity of four CNRS laboratories. Founding member of this association, we are also member of its Executive Board, where we are in charge of the research animation within EuroVR, by managing the launching and support of Special Interest Groups (SIGs). The EVE system mentioned above was inaugurated in May 2010, during the EuroVR-EVE 2010 meeting (http://eurovr-eve-2010.limsi.fr/), under the patronage of this association. With 93 participants from 12 nations, the meeting was not only the international debut of a very innovative scientific tool, but also the opportunity to bring together the main European actors of the V&AR

community to start the activity of three of the EuroVR SIGs. Concerning our international academic collaboration with the University of Zhejiang, *Weize Zhang* defended his PhD thesis in China in June 2010, after spending one doctoral visiting year within our team (2008-2009) to work on the SACARI Augmented Virtuality project (see topic 1).

At the national level, the VENISE group has led the ANR "CoRSAIRe" project, completed in November 2009, on the problem of multimodal supervision of multi-sensorimotor immersion (stereoscopic 3D audio and haptic) and its contribution to the immersive analysis of massive data (topics 1 and 2). Working for this research contract but with PhD funding of the French government, *Bob Ménélas* defended his thesis in September 2010 and, after one postdoctoral year at University of Calgary, is now associate professor at University of Quebec. We were also a partner of the ANR "Perf-RV2" project which ended in June 2009, and the PhD work of *Flavien Picon* on the use of haptics for CAD edition in immersive situations was completed in June 2010. Furthermore his haptic & CAD expertises were noticed by Thales Alenias Space (Turin), a former partner of INTUITION NoE, which hired him on a postdoctoral position of the EC "ManuVAR" project. After this postdoc he joined the renowned team of Professor *N. Magnenat-Thalmann* in Singapore. Another outcome of our partnership in the Perf-RV2 project is the decision of PSA Peugeot-Citroën to develop a closer collaboration with the VENISE group on the issue of product design in immersive situations (topic 2). In this context, a CIFRE fellowship was obtained from ANRT to support the PhD of *Pierre Martin* which started in May 2011. A major event of the past two years has been the selection of the Equipex DIGISCOPE project in 2010. This project, which builds on the existing equipment already present on the Plateau de Saclay, aims at creating a unique center of expertise for the visualisation and collaborative interaction with massive and complex data. This project was importantly built on the collaborations that had started during the SIMCoD project, in particular with the LSI team at CEA-LIST, on the subject of co-localised and remote collaborative immersion. Although mainly academic, this project also associates industrial partners and in particular PSA Peugeot-Citroën reinforcing our existing collaborative relationship. Finally we continued our partnership within the ANR grant "EVEILS" (Virtual Spaces for Education and Scientific Illustration), the aim of which is to use immersive environment to illustrate and convey the physical phenomena at the heart of relativistic physics. The PhD thesis of *Tony Doat* is planned to be defended in 2012. In terms of scientific animation, we co-organized with the CEA-LIST the 5th annual meeting of AFRV (French association of V&AR) in December 2010. This meeting (http://afrv2010.limsi.fr/) gathered 167 participants, and its program included 3 international invited keynote speakers: Pr. *Doug Bowman* (Viginia Tech), Pr. *Paul Milgram* (Univ. of Toronto), and Pr. *Hideo Saito* (Keio University).

At the local level, on one hand, we got involved in the 2010-2013 habilitation project of the Master course in Computer Science of the University Paris-Sud. We proposed a number of courses related to the V&AR field to the Interaction speciality of this Master, including one mandatory teaching module (lectures + tutorials). On the other hand, within a partnership with the AVIZ team of INRIA-Saclay, we obtained a RTRA Digiteo Chair position (3-year research position starting in September 2010) for *Tobias Isenberg*, assistant professor at the University of Groningen (The Netherlands). The chair, called AVENIR, focuses on non-photorealistic visual rendering and the use of interactive tables to explore complex data sets. The interest of the VENISE group is to use such visual rendering techniques for CFD applications, and study the use of such interactive table as an alternative or in conjunction with the EVE immersive system.

Research presentation

Topic 1: Interaction Models for V&AR

P. Bourdot, N. Férey, T. Isenberg, D. Touraine, J.-M. Vézien, P. Cazaux, W. Chen, T. Klein, P. Martin, B. Ménélas, F. Picon, C. Prat, W. Zhang, S. Villien with participation of B. Katz (A&A)

Sensorimotor channels for Immersion

This subtopic aims at developing new metaphors and interactive paradigms based on the three main sensorimotor channels of V&AR, namely visual stereoscopy, 3D audio, and haptics. The focus here is not the realistic rendering of scenes but rather the study of the contribution of these 3D feedback modalities towards facilitating user interactions and collaborations during immersive applications.

This research was initiated within the former ANR "CoRSAIRe" project and was the subject of the PhD thesis of *Bob Ménélas* [T1]. The first part of this work consisted in studying the role of haptics in the exploration of large data sets [A4], from which we proposed different multimodal methods (combining haptics and 3D audio) dedicated to facilitate the exploration process [C10, C11]. The second part of his PhD applied the generic approaches developed previously on the exploration of a specific data set derived

from CFD simulations in an open cavity (related to topic 2). Two multisensory methods of analysis have been proposed [D7, T1] based on specific features of the phenomenon and an in-depth analysis of user requirements.

We also investigated the assistance that sensorimotor VR technologies can offer for the completion of some tasks. Previously we had developed new haptic solutions to select CAD components. *Flavien Picon* extended this work during his PhD thesis [T2] on the contribution of haptic interactions during modifications of CAD objects. First, we proposed novel solutions to perceive information on curves' geometry using haptic interaction, before and during their editing. Second, a prototypical case of CAD edition has been studied (namely extrusion), where we particularly highlighted the contribution of the haptic channel for the perception of geometric referents [D1, D9]. This work is related to a thorough study of a data model that makes it possible to really integrate VR technologies in CAD systems (see topic 2).

Multimodal and Collaborative Immersion

Our work on multimodal fusion in immersive situation, supported by the ANR "Perf-RV2" project until June 2009, was extended during the period 2010-2011 thanks to the Digiteo "SIMCoD" project, to the immersive interactions in Collaborative Virtual Environment (CVE). Let us recall that one original feature of the EVE system is to allow for a multiuser co-localised immersion and more precisely, for two user groups to perceive two separate views of the virtual world (thanks to a double-stereoscopy technology that combines an "active" separation of two "passive" stereoscopic views).

Over this period, we focused on the evolution of our solutions of multimodal supervision so that they can manage multiple local and/or remote users. First, the haptic modality has been integrated in the multimodal fusion process as an outcome of the Perf-RV2 project. Second, the multi-user representation of events, although being part of the initial specifications of the multimodal software engine, had neither been implemented nor tested. So we demonstrated that our multimodal supervising engine makes it possible to combine actions from several users at different stages of the input merging process: (i) by solving *co-references* between 3D events of one or several users, (ii) by building multiuser commands, and (iii) by managing competing commands delivered by a number of users. The outcome of this work is the MalCoMIICs application (**M**ultimod**al** and **Co**-localized **M**ulti-user **I**nteractions for **I**mmersive **C**ollaboration**s**), whose a video was selected and presented at VR 2011, the best international conference in the VR research field. Moreover two papers have been published in this conference and in 3DUI 2011 [C8, C9].

Reconfigurability of the software engine (via XML files) enables a broad spectrum of experiments on the contribution of multimodal management of immersive interactions for collaborative tasks. In particular, a study was initiated by the VENISE group with the LIMSI ergonomists (namely *Françoise Darses* and *Céline Clavel* of the CPU group) to analyze how two subjects, seeing each other in the immersive system, can achieve a collaborative task in a virtual scene for which they have an individual depth perception based on their respective location. In the middle term, we plan to study the systemic and ergonomic differences which may exist in immersive collaboration between co-localised users and remote ones. A PhD thesis is about to start to support this research activity.

Mixed Reality

During this period we continued our research in Augmented Virtuality for telepresence and telesupervision. The SACARI project (Supervision of an Autonomous Car with Augmented Reality Interface) aims to develop the concepts and techniques dedicated to the immersive teleoperation of a semi-autonomous vehicle. One must notice that the vehicle itself is developed with the ACCIS team of IEF.

In 2010, a first study was carried out to validate the control and remote driving interface of a limited range electric vehicle (robotic wheelchair) in an outdoor environment, in the context of the Masters internship of *Pierre Cazaux*. The beginning of the PhD of *Pierre Cazaux* then consisted in evaluating the conditions of the creation of an effective immersive telepresence control. The phenomenon of presence is not identified in a sufficiently explicit and unequivocal fashion in the literature, so we crafted a new definition of this perception, by including cognitive considerations, and designed an experiment to measure the presence "at a distance". This experiment involves measuring the driving performance of subjects, the evaluation of the affordance perceived by them, and finally comparing the remote driving experience and the equivalent in situ experience. Evaluations conducted in 2011 revealed that the presence must indeed combine classic immersion criteria (evaluated with a questionnaire after the test was taken) with an assessment of the user involvement in the task at hand. This involvement is even stronger if the remote driver clearly perceives the context of the task correctly and if the system puts him into a perception-action feedback loop that respects the driving affordance [C1].

In 2011, our focus shifted on the pre-attention processes that guide the operator's attention on specific features detected in the environment, such as other vehicles or pedestrians. Detected early in the perception pipeline, acting on a preconscious level, these processes are particularly useful for alerting and focusing attention on potential dangers. The research conducted in 2011 during the Masters internship of *Sylvain Villien* consisted in designing a protocol for the evaluation of pre-attentional stimuli (both visual and audio clues) in order to determine which ones should be presented (nature, number) and how to present them (color, form, temporal variation) in a remote control system. The development phase was completed at the end of 2011, and the evaluations of the pre-attentional protocol will take place in 2012, completing the work of IEF on the extraction of pre-attentional visual cues in real image sequences.

Interactive and Illustrative Scientific Visualization

Tobias Isenberg's work has concentrated on his Digiteo chair topic "Advanced Visual Exploration with Non-photorealisitic and Interactive Rendering" (AVENIR). As part of this topic, he has focused on the topics of non-photorealistic rendering, illustrative visualization [C6, C7, C12], interactive exploration of scientific visualization [C13, D6], human-computer interaction [C2], and the evaluation of visualization. Specifically, he has explored the realization of dedicated control of abstraction in illustrative visualization in order to allow people to make mental connections between different abstraction stages of visualizations [C12] as well as the use of line-based visualizations to clearly depict the spatial aspects of fluid flows [C6]. An extended abstract and poster about the dedicated control of abstraction in the context of molecular visualization has received the Best Abstract Award at the IEEE BioVis 2011 symposium. In addition, Tobias has worked on the topic of using touch-sensitive display environments for the interaction with three-dimensional scientific data [D6]. For example, in collaboration with the AERO team at LIMSI–CNRS he has worked on a touch-based interface for the exploration of simulations from fluid mechanics. As part of this work, an innovative re-configurable large touch-sensitive display was constructed, facilitating the interactive exploration of scientific data. The interactive visualization project realized with AERO team on this setting is one of the fundamental results of the mentioned DIGITEO chair funding and was accomplished in close collaboration with *Tijmen Klein*, a Dutch exchange student from the University of Groningen, the Netherlands, who visited LIMSI to work with Tobias on a five-month scientific internship. The result of his work has been accepted for presentation at the EuroVis conference in 2012 and will be published in the Computer Graphics Forum.

Topic 2: Data models and simulations

N. Férey, J.-M. Vézien, S. Boivin16, P. Bourdot, D. Aurat, T. Doat, P. Martin, B. Ménélas, S. Noury, F. Picon

Interactive Molecular Simulation

The interactive molecular simulation approach consists for users to observe in real time the result of a simulation in progress and to manipulate the simulated object using classical or virtual reality interaction devices. On the one hand, this approach provides a quality control of new simulation models, and on the other hand, it allows one to interactively trigger and study some events that are not accessible in classical simulation, because of the rarity of these events and the limited simulation timescale. Moreover, in this approach the expertise of the researcher can be used during the simulation process that is necessary for the study of specific biophysical phenomena (including protein docking or folding), exclusively mobilized after the simulation process during the analysis stage of classical simulation results. This significantly shortens the simulation and analysis task loop, increases the relevance of the results, and thus decreases the amount of data to analyze after the simulation.

In this context, during the final step of the ANR project "CoRSAIRe", that aims at studying different kinds of sensory-motor feedback (visual, haptic, and audio) for scientific data analysis, we work on a high precision haptic manipulation and haptic force feedback dedicated to a virtual protein docking task. To compute and haptically render protein collisions, we designed a new haptic manipulation paradigm that allows user to manipulate and to feel atomic collisions using van der Waals interactions at the protein surface.

In this precedent project, we used a rigid molecular model using the PyMol visualization platform, to only focus on the rendering and the multimodal supervision. However in several cases, protein docking involves large protein conformational changes. Following on his postdoctoral works and his previous collaborations in the Laboratory of Theoretical Biochemistry, *Nicolas Férey*, recruited as associate professor since the end of 2009, works on multi-scale and interactive molecular simulation model, taking profits of interaction

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[16] INRIA Researcher within VENISE until March 2010

modalities traditionally used in Virtual Reality. This approach was published in an international conference [C3] a high impact factor journal [A5] and a book chapter published in 2012.

Finally, the ANR project ExaViz (Modèles Numériques 2011) started in September 2011, and is focused on the storage, analysis, and visualization of molecular simulation data of large-scale molecular simulation results (Exascale) in a virtual context.

Interactive CFD simulation

Furthermore, other works have been carried out to apply several concepts coming from the interactive molecular simulation to the computational fluid mechanics field, especially on unsteady flows. The first issue is to provide real-time simulation, keeping the necessary accuracy to be physically relevant for the researchers, in the order to carry out analysis on the physical phenomena in Virtual Environment. This task is more complicated in the fluid simulation field than for the molecular simulation. To access to real-time in fluid mechanics, the main approach was to adapt and parallelize existing fluid mechanics codes available, using recent implementation and parallelization methods close to hardware (GPU, CUDA, OpenCL...). Sébastien Noury carried out this work during the two first years of his Ph.D, under the supervision of Samuel Boivin2 and O. Le Maître. This work required the acquisition of advanced skills and involved a heavy research work to parallelize existing codes [D8]. In this context, N. Férey and S. Noury obtained a GENCI / Caps Company project which benefits from the expertise of engineers specializing in porting and parallelizing code on GPU, to evaluate the relevance of the fined-grained parallelization approaches (GPU), on the problem of pair wise bounded distance between particles computation, a classical problem in particle-based numerical simulation.

The second issue is to provide a real time and interactive control during a CFD simulation. A work carried out by *N. Férey*, addresses this prospective research topic, and aims at evaluating the feasibility and the interest of such a tool, and how to couple interaction, simulation and visualization component, and finally identify the scientific locks related to the achievement of an Interactive Virtual Wind Tunnel software platform. The first step of this work was to set up software and hardware context to allow user an immersive exploration of simulation results. We have in the second step to address the navigation and interaction issues with these data, and then integrate some of our results, first in terms of graphics rendering and real-time simulation [B2, B3], second on haptic and audio feedbacks especially designed to study CFD simulation data (see *B. Menelas* Ph.D work reported in topic 1)

Simulation of Physical phenomena inaccessible to direct experience

Started in 2009, this activity aims at exploring a multidisciplinary approach involving physicians as well as didactics and Virtual Reality specialists. While VR classically simulates our immediate physical environment to reproduce its properties, our goal is to explore situations that are inaccessible to direct experience. The ANR project "EVEILS" (Virtual Spaces for Education and Scientific Illustration) focuses on two disciplines: Relativity and large scale gravitational phenomena. Since 2010, the topic of *Tony Doat*'s PhD thesis is the design of a simulation engine for relativistic physics. This 4D simulation engine puts to use the fundamental equations of relativity physics to compute, for each instant and for each object, which 4D (past) event generated the photons that strike the virtual camera. This calculation is performed in real time thanks to a GPU implementation, and exploits the notion of space-time invariant [C4, C5]. In parallel, a didactic study conducted in collaboration with the André Revuz Laboratory of Université Paris-Diderot, identified the main obstacles to understanding the basic concepts of relativistic physics. This work shows that the notion of relativity of simultaneity, the non-absolute nature of time, and the (finite) propagation time of photons are common sources of misunderstandings and misjudgments on the part of physics students at all levels.

In the summer of 2011, the work of EVEILS eventually led to the design of the first evaluation experiments [D4]. They consisted in semi-structured interviews around a simulated interactive relativistic billiard, with the aim of getting students to understand, by immersive interaction, the nature of the phenomena involved. Careful assessment of the results led to the development of a second wave of experiments planned for 2012.

*Illustration 1 - **Interactive simulation of a relativistic carrom billard game in the EVE system**: the user shoots a ball at a speed close to the speed of light thanks to an haptic interface and observes its interactions with other balls in the 3D scene (cf. ANR "EVEILS" project – topic 2)*

VR-CAD integration

The general goal of this research is to study the integration of Virtual Reality (VR) and Computer-Aided Design (CAD). Our approach aims to create a VR-CAD framework to enable intuitive and direct 3D edition on CAD objects within Virtual Environments (VE). Such a framework can be applied to collaborative part design activities and to immersive project reviews, in relation to Product Lifecycle Management (PLM). The cornerstone of our approach is a model we started to elaborate in 2003, which manages implicit editing of CAD objects. This model uses a naming technique of *B-Rep* components and a set of logical rules to provide straight access to the operators of *Construction History Graphs* (*CHG*). Another set of logical rules and the replay capacities of CHG make it possible to modify in real-time the parameters of these operators according to the user's 3D interactions.

When using this model within a multimodal immersive interaction (combining for instance, 6 DoF tracking, speech and gesture recognition), we gain a direct and intuitive edition of the shapes of objects within a VE, thus avoiding explicit interactions with the CHG within a classical WIMP interface. However, free-hand gesture interactions with CAD objects in a VE are lacking accuracy. *Flavien Picon*'s PhD aimed to elaborate several haptic paradigms specially conceptualized and evaluated to provide an accurate perception of B-Rep components, and to help the user during his/her 3D interactions (thanks to virtual *haptic guides* and *geometric referents* that users may perceive haptically). Apart from the publication already reported in topic 1 about these works on haptics, a detailed paper of our main VR-CAD results was published in one of the best journal of the domain (CAD Elsevier) [A1]. In addition, we are deeply involved in the animation of the SIG « Design, Engineering, Manufacturing » of EuroVR, a focus group we initiated during the EuroVR-EVE 2010 meeting.

*Illustration 2 – **MalCoMIICs** (**M**ultimod**al** and **Co**-localized **M**ulti-user **I**nteractions for **I**mmersive **C**ollaboration**s**): In a virtual assembly chain, two users cooperate in the EVE system with speech, two-hand gestures, haptic feedbacks, and double-stereoscopy to define the trajectory of a seat which must be set it in the cockpit of a car (cf. Digiteo "SIMCoD" project – topic 1).*

The main showcase of our VR-CAD framework was implemented on OpenCASCADE. However our model is based on fundamental concepts of CAD systems (CHG, B-Rep, form feature, persistent naming), so we are working on the generalisation of this framework, in order to apply it in several popular commercial CAD systems. In 2011 we obtained a CIFRE fellowship with Peugeot-Citroën to support the PhD of *Pierre Martin*. A

first objective of his PhD work is to perform a comprehensive evaluation of our VR-CAD interactive solutions with expert subjects (CAD engineers, and more generally, design product actors). On the fundamental side, we want to define an optimal but generic interface between our labelling technique and the proprietary persistent naming format of targeted CAD systems. Our ultimate goal is to provide a complete solution to design product actors dedicated to the intuitive modification of CAD models during immersive project reviews.

Highlights

- Completion of the EVE large scale immersive environment
- Inauguration of the EVE immersive environment by holding the EuroVR symposium in may 2010 and the AFRV days in decembre 2010
- Labellisation of EVE into the Digiscope Equipex

Staff

Permanent Staff

Firstname	Lastname	Type of position	Employer	HDR	Arrival date	Departure date
Patrick	Bourdot	CR Researcher	CNRS	HDR		
Nicolas	Ferey	Ass. Prof.	U-PSud			
Damien	Touraine	Res. Eng.	CNRS			
Jean-Marc	Vézien	Res. Eng.	CNRS			

PhD Students

Firstname	Lastname	Graduate school	University	Type of support	Start date	Date of defense
Tony	Doat	EDIPS	U-PSud	CDD CNRS ANR BLANC	01/06/2009	
Pierre	Martin	EDIPS	U-PSud	CIFRE/CDDPSA	01/05/2011	
Bob	Menelas	EDIPS	U-PSud	MNRT PhD grant	01/10/2007	30/07/2010
Huynh-Phong	Pham	EDIPS	U-PSud	Italian PhD Grant	02/05/2007	31/03/2010
Flavien	Picon	EDIPS	U-PSud	MNRT PhD grant	01/10/2006	29/06/2010
Weize	Zhang	EDIPS	U-PSud	China PhD grant	01/09/2008	30/06/2010

Non permanent staff

Firstname	Lastname	Type of position	Employer	Arrival date	Departure date
Tobias	Isenberg	Digiteo Chair	CNRS	01/09/2010	31/08/2013
Pierre	Martin	Post-Doc	CNRS	01/11/2009	30/10/2010
Clément	Pillias	Post-Doc	CNRS	05/12/2011	30/06/2012

Indicators of scientific notoriety

Prizes and awards

- Wouter Lueks, Ivan Viola, Matthew van der Zwan, Henk Bekker, and Tobias Isenberg, Best Abstract Award at the 2011 IEEE Symposium on Biological Data Visualization : "Spatially Continuous Change of Abstraction in Molecular Visualization".
- Maarten H. Everts, Henk Bekker, Jos B. T. M. Roerdink, and Tobias Isenberg , Best Paper Award at the ASCI CONFERENCE 2010 : "Illustrative Rendering of Dense Line Data ".

Editorial committees in journals

- Associate Editor of Elsevier Computers & Graphics : T. Isenberg
- Guest Editor of the special section of Elsevier Computers & Graphics for the best papers of the 2011 Joint Symposium on Computational Aesthetics, Non-Photorealistic Animation and Rendering, and Sketch-Based Interfaces and Modeling : T. Isenberg
- Guest Editor of the special section of Elsevier Computers & Graphics on Non-Photorealistic Animation

and Rendering (volume 35, number 1, February 2011) : T. Isenberg

Organization of international or national scientific events

Member of the scientific, technical program and/or organizational committees for international/national conferences or workshops

- International scientific committee of EuroVR-EVE 2010 (Joint European Meeting « First EuroVR-SIGs workshop & EVE inauguration »), May 2010: P. Bourdot (Chairman).
- Organizing committee of EuroVR-EVE 2010, May 2010: P. Bourdot (Chairman), J.-M. Vézien, N. Férey, D. Touraine.
- Organizing committee of the 2010 National meeting of the French Association of Virtual Reality (AFRV), Dec. 2010: P. Bourdot (Chairman), J.-M. Vézien, N. Férey, D. Touraine.
- General conference chair CAe 2011 : T. Isenberg
- Organization of DEXIS 2011 : T. Isenberg
- Program committee member and reviewing for VRIC 2010 : P. Bourdot
- Program committee member and reviewing for IEEE Visualization 2010 and 2011 : T. Isenberg
- Program committee member and reviewing for ACM NPAR 2011 : T. Isenberg
- Program committee member and reviewing for IVNHDE (special track of ISVC 2011) : T. Isenberg
- Program committee member and reviewing for TAVA 2011 (special track of i-KNOW 2011) : T. Isenberg
- Program committee member and reviewing for ASCI 2010 : T. Isenberg
- Reviewing for DEXIS 2011 : T. Isenberg

Invited lectures, talks or seminars

Keynote speaker at international conferences

- P. Bourdot. VR for Design & Engineering: some approaches investigated with mutlimodal and collaborative interactions. 8th Congress on Virtual Reality Applications (CARVI 2010). Vitoria-Gasteiz (Spain), November 2010.
- P. Bourdot. VR for Design & Engineering: some approaches investigated with mutlimodal and collaborative interactions. 8th Congress on Virtual Reality Applications (CARVI 2010). Vitoria-Gasteiz (Spain), November 2010.

Participation in expertise and administration of research

International or national scientific networking

International networks

- P. Bourdot: Founding member of EuroVR (European association of Virtual Reality) and member of Executive Board in charge of scientific animation of Special Interest Groups (SIGs).

National networks or working groups

- J.-M. Vézien: member of the Information Signal Image and Vision (ISIS) GdR and LIMSI correspondent for ISIS.

Participation in evaluation or expertise committees

National committees (CoNRS, CNU, CCSU…)

- P. Bourdot, N. Férey, CCSU members of the Computer Sciences department at University Paris-Sud: Expert for scientific evaluation committees

Member of the administration or advisory board

- P. Bourdot: Partner leader & member of the Scientific Board of the Equipex « DIGISCOPE » project (2011-2019)
- J.-M. Vézien: Co-chair of the Technical committee of the Equipex « DIGISCOPE » project.

Member of selection juries

- P. Bourdot, D. Touraine: Experts for the "Alberta Science and Research Investments" (Canada).

Teaching activities and duties in relation to research

- J.-M. Vézien: « Vision by Machine » Course of the Master Professional of the Ecole Doctorale d'Informatique of Université Paris-Sud, in 2009 et 2010.
- J.-M. Vézien : « Vision par ordinateur et Reconnaissance des Formes » Course of « Automatic » section of 3rd year of Ecole Supérieure d'Electricité (Supelec), in 2009 and 2010.
- P. Bourdot (resp.), S. Boivin, J.-M. Vézien, and Nicolas Férey : « Réalité Virtuelle et Augmentée » course of the Interaction Master of Université Paris-Sud, in 2010 and 2011.
- S. Boivin: « Synthèse d'Images Avancées » module in third year of Polytech Paris-Sud Engineering School, 2010.
- J-M. Vézien: « Augmented Reality » introductory course of third year of PolyTech Orleans Engineering school (Nov 2011).
- N. Férey, J-M. Vézien, P. Bourdot: Installation and operation of a Virtual and Augmented Reality teaching room (3D visualization, 3D audio, haptics) at the Computer Science department of Université Paris Sud.
- T. Isenberg: Innovative Interactive Systems class (2010 and 2011) at the University of Groningen, the Netherlands.
- T. Isenberg: Computer Graphics class (2010 and 2011) at the University of Groningen, the Netherlands.
- T. Isenberg: Advanced Computer Graphics class (2010 and 2011) at the University of Groningen, the Netherlands.
- T. Isenberg: Guest block class on Non-Photorealistic Rendering (2011) at the University of Granada, Spain.

Dissemination and vulgarization

- P. Bourdot: Interview « Ca fait quoi de plonger tous ses sens dans le Virtuel ? » Sciences et Découvertes. Jérémie Bazart, Humanité Dimanche. 23-29 Sept., 2010.
- P. Bourdot: Interview « EVE : Le futur de la réalité virtuelle et augmentée à Saclay ». Elsa Bellanger, Innovation le journal. 17 May, 2010 ; (http://www.innovationlejournal.com/spip.php?article5595).
- P. Bourdot: Interview « La réalité virtuelle prend corps sur le plateau de Saclay ». Théo Delpont-Ramat, Banque des Savoirs. 17 May, 2010 ; (http://www.savoirs.essonne.fr/sections/actualites/la-realite-virtuelleprend-corps-sur-le-plateau-de-saclay/)
- P. Bourdot: Interview « Un système novateur de réalité virtuelle et augmentée sur le plateau de Saclay ». Julien Guillaume, Sophie Palès, and Cateline Chapuis-Lévèque, Communiqué de Presse du CNRS. 7 May, 2010 ; (http://www2.cnrs.fr/presse/communique/1874.htmglobal)
- J-M. Vézien: Conference « L'ombre et la Science » as part of the PICRI project « Toute la lumière sur l'ombre », Janvier 2010, Taverny, France

Research conventions and contracts

Industrial relationships

- P. Bourdot, J.-M. Vézien, D. Touraine, P. Martin, P. Cazaux. Vecsys, Haption S.A. and Intempora, in the framework of the RTRA Digiteo « SIMCoD » project (2007-2011)
- P. Bourdot, P. Martin. Research convention with PSA Peugeot-Citroën (2011-2014)

Contract table

Acronym	Funding agency/Partner	Program	Nature	Resp. for LIMSI	General coordinator	Starting date	Ending date	LIMSI share
	Université de Gênes	PhD supervision	Research collab.	Bourdot P.	Bourdot P.	01/07/2007	30/06/2010	
SIMCoD	Digiteo	RV Platform	Research collab.	Bourdot P.	Bourdot P.	01/10/2007	30/09/2011	610200
	Région Ile de France	PICRI	Research collab.	Jacquemin Ch.	Jacquemin Ch.	27/11/2008	26/112011	74500
EVEILS	ANR	Basic science	Research collab.	Vézien J.-M.	Parizot E. (APC)	01/05/2009	31/08/2012	159085
AFRV	Digiteo	Conference support		Bourdot P.	Bourdot P.	01/12/2009	28/02/2011	7000
EuroVR-EVE	Digiteo	Conference support		Bourdot P.	Bourdot P.	01/12/2009	30/11/2010	8000
AFRV&Euro-VR	PCA		Non-disclosure agreem.	Bourdot P.	Bourdot P.	22/01/2010	21/01/2015	
AVENIR	Digiteo	T. Isenberg's Chair	Research collab.	Bourdot P.	Bourdot P.	01/09/2010	31/08/2013	349281

	GENCI/CAPS		Research support	Ferey N.	Ferey N.	01/09/2010	31/08/2011	12 months ing.
RV	PCA		Research collab.	Bourdot P.	Bourdot P.	01/10/2010	30/04/2011	33476
DIGISCOPE	Investissement d'avenir		other	Bourdot P.	Beaudoin-Lafon M. (LRI)	01/03/2011	31/12/2019	687383
	PCA	CIFRE	Research collab.	Bourdot P.	Bourdot P.	02/05/2011	01/05/2014	53626
SuCRADe	CNRS	PEPS	Research collab.	Vézien J.-M.	Vézien J.-M.	25/05/2011	31/12/2012	13000
ExaViz	ANR		Research collab.	Ferey N.	Baaden M. (LBT)	01/09/2011	31/08/2015	120536

Scientific publications

Doctoral theses and HDR

T1. Menelas, B., *Rendus sensorimoteurs en environnements virtuels pour l'analyse de données scientifiques complexes* 2010, thèse de l'Université Paris-Sud. Soutenue au LIMSI, Orsay, le 9 septembre 2010, 175p.

T2. Picon, F., *Interaction haptique pour la conception de formes en CAO immersive* 2010, thèse de l'Université Paris–Sud. Soutenue au LIMSI, Orsay, le 28 juin 2010, 209p.

T3. Zhang, W., *Learning Simple Local Features for Object Detection* 2010, thèse de l'University of Zhejiang/LIMSI. Soutenue à Zhejiang, China, June 2010.

Articles in peer reviewed scientific journals

A1. Bourdot, P., T. Convard, F. Picon, M. Ammi, D. Touraine, and J.-M. Vézien, *VR-CAD integration : multimodal immersive interaction and advanced haptic paradigms for implicit edition of CAD models.* Journal of Computer-Aided Design, 2010. **42** (5): pp.445-461.

A2. Collomosse, J. and T. Isenberg, *Special section on non-photorealistic animation and rendering NPAR 2010.* Computers & Graphics, 2011. **35** (1): pp.iv-v.

A3. Martin, D., G. Arroyo, V. Luzon, and T. Isenberg, *Example-based stippling using a scale-dependent grayscale process.* Computers & Graphics, 2011. **35** (1): pp.160-174.

A4. Menelas, B., M. Ammi, P. Bourdot, and S. Richir, *Survey on haptic rendering of data sets : exploration of scalar and vector fields.* Journal of Virtual Reality and Broadcasting, 2010. **6** (9): pp.11p.

A5. Saladin, A., C. Amourda, P. Poulain, N. Ferey, M. Baaden, M. Zacharias, O. Delalande, and C. Prevost, *Modeling the early stage of DNA sequence recognition within RecA nucleoprotein filaments.* Nucleic Acids Research, 2010. **38** (19): pp.6313-6323.

Books & chapters in books

B1. Cunningham, D., T. Isenberg, and S.N. Spencer, *Proceedings of the Seventh International Symposium on Computational Aesthetics in Graphics, Visualization, and Imaging (CAe 2011, August 5--7, 2011, Vancouver, Canada)* 2011: ACM. 139pp.

B2. Noury, S. and S. Boivin, *YAML for C++: Applied Data-Driven Design*, in *Game Development Tools*, M.A. Ed, Editor. 2011, Taylor and Francis Group, LLC. pp. 279-286.

B3. Noury, S., S. Boivin, and O. Le Maitre, *A Fast Poisson Solver for OpenCL using Multigrid Methods*, in *GPU Pro 2 : Advanced Rendering Techniques*, E. W. Engel, Editor. 2011. pp. 445-471.

Conferences with proceedings and review committee

C1. Cazaux, P., J.-M. Vézien, P. Martin, D. Touraine, N. Ferey, and P. Bourdot. *Le système EVE : aperçu des recherches en cours en immersion collaborative et en téléopération.* in *5è Journées de l'AFRV*. 2010: AFRV. 147-152.

C2. Chaboissier, J., T. Isenberg, and F. Vernier. *Real time chess: lessons from a participatory design process for a collaborative multi-touch, multi-user game*. in *ACM International Conference on Interactive Tabletops and Surfaces*. 2011. Kobe, Japan: Jun Rekimoto and Hideki Koike and Kentaro Fukuchi and Yoshifumi Kitamura and Daniel Wigdor. 97-106.

C3. Delalande, O., N. Ferey, B. Laurent, M. Gueroult, B. Hartmann, and M. Baaden. *Multi-resolution and multi-physics approach for interactively locating functionnally linked ion binding sites by steering small molecules into electrostatic potential maps using a haptic device*. in *Pacific Symposium on Biocomputing*. 2010. Hawai, USA. 205-215.

C4. Doat, T., E. Parizot, and J.-M. Vézien. *A carom billiard to understand special relativity*. in *IEEE Virtual Reality*. 2011. Singapore, Republic of Singapore. 203-204.

C5. Doat, T., E. Parizot, and J.-M. Vézien. *Novative Rendering and Physics Engines to Apprehend Special Relativity*. in *Joint Virtual Reality Conference of EuroVR - EGVE - VEC*. 2011. Nottingham, UK: Coquillart, S. AND Steed, A. AND Gregory Welch, G. (eds.). 9-18.

C6. Everts, M.H., H. Bekker, J.B.T.M. Roerdink, and T. Isenberg. *Illustrative line styles for flow visualization*. in *Pacific Conference on Computer Graphics and Applications*. 2011. Kaohsiung, Taiwan: Bing-Yu Chen and Jan Kautz and Tong-Yee Lee and Ming C. Lin. 105-110.

C7. Everts, M.H., H. Bekker, J.B.T.M. Roerdink, and T. Isenberg. *Flow visualization using illustrative line styles*. in *National ICT.OPEN/SIREN 2011 Workshop*. 2011: IPN / NWO / STW. 33_1-33_6.

C8. Martin, P. and P. Bourdot. *Designing a reconfigurable multimodal and collaborative supervisor for Virtual Environment*. in *IEEE Virtual Reality*. 2011. Singapore, Republic of Singapore. 225-226.

C9. Martin, P., P. Bourdot, and D. Touraine. *A reconfigurable architecture for multimodal and collaborative interactions in virtual environments*. in *IEEE Symposium on 3D User Interfaces*. 2011. Singapore, Singapore: IEEE CS Digital Library. 11-14.

C10. Menelas, B., L. Picinali, B. Katz, and P. Bourdot. *Audio haptic feedbacks in a task of targets acquisition*. in *IEEE Symposium on 3D User Interfaces*. 2010. Waltham, USA. 51-54.

C11. Picinali, L., B. Menelas, B. Katz, and P. Bourdot. *Evaluation of a haptic / audio system for 3-D targeting tasks*. in *Convention of the Audio Engineering Society*. 2010. London, UK. 11p.

C12. Van der Zwan, M., W. Lueks, H. Bekker, and T. Isenberg. *Illustrative molecular visualization with continuous abstraction*. in *IEEE Annual Symposium on Visualization*. 2011. Bergen, Norway. 683-690.

C13. Vlaming, L., C. Collins, M. Hancock, M. Nacenta, T. Isenberg, and S. Carpendale. *Integrating 2D mouse emulation with 3D manipulation for visualizations on a multi-touch table*. in *ACM International Conference on Interactive Tabletops and Surfaces*. 2010. Saarbrücken, Germany. 221-230.

C14. Zhang, W., J.-M. Vézien, R. Tong, P. Bourdot, and J. Dong. *Hough-transformed contour line segments for object detection*. in *IADIS International Conference on Computer Graphics, Visualization, Computer Vision and Image Processing*. 2010. Freiburg, Germany. 235-242.

Conferences without proceedings, workshops

D1. Bourdot, P. *VR for design & engineering: some approaches investigated with mutlimodal and collaborative interactions*. in *Congress on Virtual Reality Applications*. 2010. Vitoria-Gasteiz, Spain.

D2. Bourdot, P. *Synthesis on the Special Interest Groups sessions, and general discussion on SIGs*. in *2nd EuroVR SIG Meetings*. 2010: JVRC 2010.

D3. Bourdot, P. *Multi-sensory-motor & Co-localised interactions for Collaborative Immersion and Tele-operation : some research in progress on the EVE system*. in *4th EuroVR SIG Meeting*. 2011: EuroVR.

D4. De Hosson, C., T. Doat, I. Kermen, E. Parizot, and J.-M. Vézien. *Designing learning scenarios for 3D virtual environment: the case of special relativity*. in *International Conference on Physics and Education*. 2011. Mexico city, Mexico.

D5. Doat, T. and J.-M. Vézien. *Virtual Reality to experiment out-of-reach physics in a relativistic framework: progress report*. in *First EuroVR-EVE SIG Meeting*. 2010. 2.

D6. Isenberg, T. *Position paper: touch interaction in scientific visualization*. in *Workshop on Data Exploration on Interactive Surfaces (DEXIS 2011)*. 2011: ACM. 4p.

D7. Menelas, B. and P. Bourdot. *Multisensory rendering for virtual exploration of large of large CFD datasets*. in *1st EuroVR SIG Meeting*. 2010: EuroVR.

D8. Noury, S., S. Boivin, and O. Le Maitre. *Toward real-time fluid simulation for virtual reality*. in *First EuroVR-EVE SIG Meeting*. 2010: EuroVR. 4p.

D9. Picon, F. and P. Bourdot. *Haptic interaction for CAD editing in VR*. in *First EuroVR-EVE SIG Meeting*. 2010: EuroVR. 6p.

Virtuality, Interaction, Design and Art (VIDA)

Christian Jacquemin et Nathalie Delprat

Introduction

VIDA (Virtuality, Interaction, Design, & Art) is a collaborative theme that gathers researchers, PhD students, and engineers working in collaboration with creative professionals (artists, designers, architects..) and interested by interdisciplinary approaches, including interactions with Human Sciences. Created in 2006 by Ch. Jacquemin as a theme of VENISE, hosted during 2010-2011 by AMI group, VIDA became a transverse action as of March 2012. VIDA gathers members of various LIMSI's groups and covers 3 themes:

- Virtual and Augmented Reality for the performing arts, architecture and visual arts,
- Multimodal human-computer interaction for social life, music, dance, or theater performance,
- Virtual materiality for cognitive experiments in arts and science.

Most projects developed in VIDA have been published both as scientific works and as artistic events such as live performances, exhibitions, or art/science mediations in public space. In addition to dual publishing, an art/science collaboration is considered as successful if both the artist and the scientist end up with an original research topic that would not have emerged if they had not worked together. Some of these projects are reported here. More details and other projects can be found on VIDA wiki http://vida.limsi.fr/.

VIDA has fostered the development of new themes at LIMSI and involved permanent researchers or PhD students for short or long term projects. The diversity and the quality of the publications confirm the potentialities of this research area. Its echo in the local, national, and international academic community shows that LIMSI is now recognized as a major actor in this area.

Research presentation

Topic 1: Virtual and augmented reality in arts

R. Ajaj, C. d'Alessandro, M. Ammi, T. Bouchara, W. K. Chan, M. Courgeon, N. Delprat, S. Fdili Alaoui, E. Frenoux, C. Jacquemin, B. FG Katz, S. Le Beux, J-C Martin

Digital media are now involved in the design of many artworks, either during the production phase, or as part of the work itself. Artistic uses of Virtual or Augmented Reality as part of the art piece focus on issues such as immediacy and intuitiveness (so that the onlooker can be quickly and spontaneously engaged in the work), presence (so that the viewer perceives her-/himself as part of the work), and continuity (so that the real and the virtual world appear as perceptually and cognitively connected).

Genius Loci is a performance for a single actor that has brought together a laboratory on Heritage digitization and architecture (*MAP*), a theater company (*Laboratoire Victor Vérité*), a culture center and museum (*La Chartreuse, Centre National des Écritures du Spectacle)*, and *LIMSI*. The purpose of the collaboration was to consider how 3D scans of a built environment and historical hypotheses could be combined with graphical synthesis and calibration for the digital augmentation of a historical building. Through this work we have been able to recycle 3D models obtained through laser scanning into an Augmented Reality application through geometry overlay on the inner walls of a disused church. Both raw outputs of laser scans and reworked historical hypotheses have been used as a basis for realistic rendering or stylized graphics. The project has been shown in summer 2011 at La Chartreuse during the Avignon Theater Festival and was very well received by the public.

Illustration 1 – Rendering of stylized graphics based on the geometrical deformation of a 3D mesh produced through laser scanning of a historical church. The mesh is slightly extruded from the walls for a low-relief rendering. Real-time animation and rendering is based on geometry shaders that are used for geometry refinement and live interpolation. For some parts of the performance, the graphics were synchronized with, and animated by the soundtrack. July 2011, La Chartreuse-lèz-Avignon, France. (photo credit Aurélie Favre-Brun)

Toute La Lumière Sur L'Ombre (*Shedding Light on Shadow*) is a 3-year project focusing on the use of shadow as an area for live and interactive video-projection. This project results from the collaboration between two theater companies (*didascalie.net* and *L'Ange Carasuelo*), a mediatheque (*Les Temps Modernes,* Taverny) and LIMSI for the scientific and engineering part. This project has explored two ways for interacting with shadow: a mainstream and well-studied technique of silhouette capture, and a more original one, in which cast shadow is detected and used as a mask for video-projection. The project has offered new insights on the use of shadow both as a feedback and as an interactor. Several experiments have been conducted with children, teen-agers, students or performers. A theater play and several pieces have been based on the environment developed during the course of the project. The last developments have involved a designer and have resulted in a portable installation for cast shadow-based video-projection.
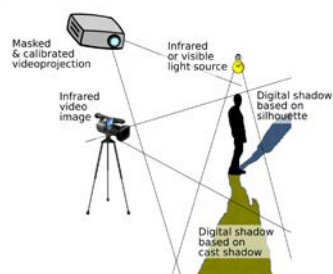
Illustration 2 – The two techniques explored for using digital shadow as a mask for video-projection and as an interactor: silhouette or cast-shadow based digital shadow. Both techniques can be rendered simultaneously with or without infrared only lighting depending on the expected visual effects. The video capture is restricted to infrared range in order to avoid undesirable feedback effects.

SoundDelta - In the context of artistic spatial soundscapes for public exhibition, using traditional audio augmented reality technologies, the computational costs increase directly with the number of concurrent users. While systems for several users are conceivable by simply utilizing more processing power, large scale installations are not feasible. In our role in the ANR project SoundDelta (in collaboration with the artist collective REMU, and laboratories S3/ENST and L2TI/University Paris 13), we developed a hybrid 3D audio rendering method which would allow for the individual binaural rendering of a common scene for a large number of users. The system uses a novel Ambisonic cell approach for efficient scaling of computation and network bandwidth with respect to the number of users. This design divides the physical space into cells, with Ambisonic audio rendered on the server for fixed virtual auditor positions at the center of each cell. Each human listener uses a mobile device to receive Ambisonic streams from their nearest virtual auditor.
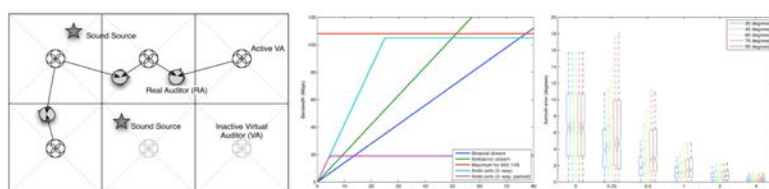
Illustration 3 - Ambisonic cell approach concept (left). Bandwidth simulations for different approaches as a function of user numbers (center). Estimated perceived angular error for the Ambisonic cell system as a function of source distance, normalized by cell size (right).

In addition to *SoundDelta*, two other ANR projects have involved the collaboration of artists and scientists, and addressed scientific issues raised by these collaborations. In the *CARE* project, emotions recognized through dance gesture analysis were used to augment a dance performance with a digital face expressing emotions. *Tophophonie* is a project for the design of granular audio-graphical scenes. It has brought together sound designers, sound and graphic researchers, and corporate partners for joint work on such multimedia scene definition and rendering.

Canal Haptique (*Haptic Canal*) project concerns the study and development of a new approach to emotional communication between two remote users. The project has been developed in collaboration with a design studio (*Fracture Numérique*) and a multimedia editor (*Anabole*). It focuses on interaction through the haptic channel and enables users to express and perceive physically different types of emotions. The platform was installed in the MK2 cinemas on both sides of Canal St Martin so that spectators could communicate the emotions aroused by the movie they had just been watching. The project was a great success of the *Futur en Seine* 2011 festival and several technological and scientific perspectives are planned.

Illustration 4 – The installation of Canal Haptique during Futur en Seine 2011. The setup consisted of an haptic device and a display located on both sides of canal. The users were passers-by or customers of the cinema who had just been watching a film. Through the haptic interface, users could either communicate emotions by manipulating the stylus, or receive force feedback from a remote user located on the other side of the canal. The visualization on the display was made of abstract patterns evoking emotional states.

Topic 2: Multimodal human-computer interaction in arts

R. Ajaj, C. d'Alessandro, M. Ammi, T. Bouchara, M. Courgeon, L. Feugère, C. Jacquemin, B. FG Katz, J-C Martin, S. Le Beux, M. Noisternig, A. Rilliard

Chorus Digitalis. Cantor Digitalis is an improved real-time formant synthesizer developed by S. Le Beux, C. d'Alessandro and L. Feugère. Intonation of the singing voice is controlled in real time with the help of graphics tablet. Vowels and voice quality are also controlled. The synthesizer is based on a source-filter model, the "source" component corresponding to glottal excitation, and the "filter" component corresponding to the vocal tract and lip radiation components of voice production. Source/filter interactions are also taken into account for improving sound quality and playability. Several personalized voice types and registers are offered. The Chorus Digital is a choir of Cantor Digitalis. With a relatively modest amount of training, reasonable musical results were obtained. The results obtained showed that intonation, ornamentation and synchronization between players achieved good levels of accuracy. The difficulties encountered in virtual choral singing are essentially the same as those encountered in real choral singing.

Illustration 5 – The Chorus Digitalis, choir of gesture controlled virtual singers.

ORA Orgue et Réalité Augmentée. (Pipe organ and augmented reality). The organ is the earliest form of sound synthesizer, featuring artificial harmonics and additive and subtractive synthesis, modulation and detuning effects, and huge combinatorial possibilities. We recently proposed experiments and concerts using digital augmentation of the pipe organ, exploring new stops, new extended techniques, and new music for this venerable instrument. The augmented organ is based on: 1/ near field sound capture inside the organ case; 2/ real-time "dry" audio signals processing; 3/ sound playback on a network of loudspeakers, either integrated to the organ loft or surrounding the tribune. The electronic sources are carefully voiced for blending with the acoustic sources and room acoustics. The augmented organ offers new organ touch (new control on the transient and sustain sounds), new stops (inharmonic mixtures) and new vocabulary for the instrument (microtonal variations, glides).

Beatiful Beasts - *Beautiful Beasts* is a generative performance for digital storytelling involving a trio made of an augmented teddy bear stuffed with sensors, a virtual character with emotional expressions, and an artist. In an audio-visual environment, the audience is invited to participate in this Mixed Reality interactive story. By manipulating the bear, the performer (Pascale Barret) modifies in real time a scenario made of soundscapes, emotional expressions of MARC (a virtual avatar designed by Matthieu Courgeon for his PhD work), his body, his face, and camera and light effects. The audience is invited to be part of the drama through RFID cards. This work questions the relationship between humans and non-humans, between arts and scientific research, and how these relationships evolve. This work is a collaboration between iMAL, Pascale Barret (artist), and LIMSI. It has been awarded the Banff New Media Institute, Interactive Screen 1.0 : Beautiful Lives prize in August 2010.

Illustration 6 – Beautiful Beasts performance. By manipulating the teddy bear and interacting with the sensors it contains (microphone, gyroscope, accelerometer…) the performer controls the evolution of the storytelling. The MARC avatar developed at LIMSI-CNRS is visible on the screen. Both its expressions and its postures are used to convey emotional responses to the interaction for the audience. (photo credit IMAL)

Topic 3: Virtual materiality for cognitive experiments in arts and science

R. Ajaj, M. Courgeon, N. Delprat, S. Fdili Alaoui, E. Frenoux, C. Jacquemin

The development of interactive simulations in immersive environments has brought physicality into virtual images, and has made users experience these environments through several sensorial modalities. Thus, many performance works in dance or theater have investigated intuitive interactions with virtual matters and explored perceptual ambiguity in new cognitive contexts. Similarly the body virtualization through its augmentation or its representation by an avatar, raises various questions on virtual materiality and offers stimulating perspectives for art-science collaborations.

NUAGE (CLOUD) is a cross-disciplinary project devoted to the implementation of an evolving tool for artistic and scientific researches. It addresses various technical and conceptual issues on the embodied exploration of an evanescent matter through the design of a cloud-avatar. The idea is to experience virtual modifications of the body density using a real-time motion capture device and a particle generator. Based on N. Delprat's former work on the imaginary aspects of a virtual matter (PEPS-CNRS 2008-09), the project has begun in 2010 with the development of a prototype using an Optitrack system, in collaboration with ESIEA-ARNUM. Two cloud types with modifiable density, wind effects and interactive zoom have been simulated. A second prototype using a Kinect has been implemented in 2011 at LIMSI. It allows for the investigation of new cloud types and the interaction between two users. Due to their physical properties, the cloud-avatar responses are extremely varied affording a great deal of freedom for expressive and creative performances.

Illustration 7 – Interaction with a stratus-avatar (K1_prototype, developed at LIMSI-CNRS). Thanks to the control of few parameters and to the mapping between the user's gestures and the cloud rendering, a wide range of body representations can be experienced. (photo credit Nathalie Delprat)

Whole Body Interaction: the case of dance gesture analysis and physical model visualization - Sarah Fdili Alaoui's PhD work is a collaborative supervision between LIMSI-CNRS and F. Bevilacqua at IRCAM. The purpose is to study gesture analysis and graphical visualization for whole body interaction starting from the notion of "movement quality" in dance. The graphical rendering produced through interaction is expected to provide the user with legible and expressive real-time representation of her/his movement quality. Interactive visualization of movement qualities is based on physical models. Intuitively, it seems possible to associate the parameters of the physical model with user's movement quality. On various collaborations with dance companies through workshops and case studies, it has been shown that the behavior of a physical model can change drastically depending on the state of its internal parameters such as strength, topology, and scale or its external parameters such as viscosity.

- Genius Loci, La Chartreuse-lèz-Avignon, July 212, Avignon Theater Festival
- Memoires d'Ombres, installation, Médiathèque Taverny, November 2011, and Mediathèque Les Ulis, January 2011.
- Encounter, Interactive Art Exhibition, ACM Multimedia, Florence, October 2011.
- Presentation and workshop during "Dance Notation Series", Amsterdam 2011.
- "Beautiful Beast" performance at the festival KISS2011 to "Casa da Musica 'in Porto in September 2011.
- Chorus Digitalis first public performance at UBC, Vancouver (P3S workshop) in March 2011.
- Presentation of NUAGE, art/science round table, fête de la Science, 13 October 2011, Créteil.
- Workshop Dans les Nuages, Researcher's Night, 23 September 2011, Palaiseau.
- ORA concert presented by C. d'Alessandro and M. Noisternig in Lille (opening concert of the European Heritage Days, sept 2010), and Paris (Festival "Le Paris des Orgues", may 2011).
- Cloud, ART fair Copenhagen, Søren Thilo Funder, Christian Jacquemin, and Toke Lykkeberg, September 2010.
- Art residency for Double Skin Double Mind installation during TKB Lab du projet TKB à Lisbon/Montemoro, spaço do tempo, 2010.
- Participation to Inside Movement Knowledge, project laboratory, Amsterdam 2010.

Staff

LIMSI members: Christophe d'Alessandro (AA), Mehdi Ammi (AMI), Tifanie Bouchara (AMI/AA), Céline Clavel (CPU), Matthieu Courgeon (CPU), Nathalie Delprat (AA), Hui Ding (AMI), Sarah Fdili Alaoui (AMI), Lionel Feugère (AA), Emmanuelle Frenoux (AMI), Christian Jacquemin (AMI), Brian Katz (AA), Joseph Mariani (TLP), Jean-Claude Martin (CPU), Angel Osorio (AMI), Gaëtan Parseihan (AA), Elisabeth Piotelat (AMIC), Albert Rilliard (AA), Jean-Paul Sansonnet (AMI), Frédéric Vernier (AMI)

External partners: Pascale Barret (artiste), Franck Bimbard (IEF), Xavier Boissarie (Orbe), Baptiste Caramiaux (IRCAM), Roland Cahen (artiste, ENSCI), Valérie de La Chapelle (artiste), Georges Gagneré (artiste), Fabienne Gotusso (artiste), Michèle Gouiffes (IEF), Hayley Hung (Amsterdam University), Claire Leroux (ARNUM-ESIEA), Markus Noisternig (IRCAM), Bertrand Planes (artiste), Diemo Schwarz (IRCAM), Marina Wainer (artiste).

Scientific publications

Articles in peer reviewed scientific journals

A1. d'Alessandro, C., *On the dynamics of the clavichord: from tangent motion to sound.* Journal of the Acoustical Society of America, 2010. **128** (4): pp.2173-2181.

A2. d'Alessandro, C., A. Rilliard, and S. Le Beux, *Chironomic stylization of intonation.* Journal of the Acoustical Society of America, 2011. **129** (3): pp.1594-1604.

A3. Delprat, N., C. Leroux, and S. Fdili Alaoui, *Experience of a cloud-avatar: Scientific challenges and artistic perspectives.* International Journal of Design and Innovation Research (IJODIR), 2011. **6** (1): pp.127-143.

A4. Jacquemin, C., R. Ajaj, S. Le Beux, C. D'Alessandro, M. Noisternig, B. Katz, and B. Planes, *Organ augmented reality: audio-graphical augmentation of a classical instrument.* International Journal of Creative Interfaces and Computer Graphics, 2010. **1** (2): pp.51-66.

A5. Jacquemin, C., R. Ajaj, and B. Planes, *Alice on both sides of the looking glass: performance, installations, and the real/virtual continuity.* Computers in Entertainment, 2011. **9** (3): pp.23.

Books & chapters in books

B1. d'Alessandro, C., *The acoustics of tangent-string interaction in the clavichord compared to hammer-string interaction in the fortepiano*, in *De Clavicordio, XI*, B. Brauchli, A. Galazzo, and J.E. Wardman, Eds. 2011, Musica Antica à Magnano. pp. 83-90.

B2. d'Alessandro, C., *Orgues, musiques et musiciens à Sainte-Élisabeth*. Vol. 91. 2011: Association Aristide cavaillé-Coll. 224p.

Conferences with proceedings and review committee

C1. Caramiaux, B., S. Fdili Alaoui, T. Bouchara, G. Parseihian, and M. Rebillat. *Gestural auditory and visual interactive platform*. in *International Conference on Digital Audio Effects*. 2011. Paris, France. 4p.

C2. Delprat, N., C. Leroux, and S. Fdili Alaoui. *In the clouds - Virtual experience of a matter*. in *Virtual Reality International Conference*. 2011. Laval, France. 5p.

C3. Feugère, L., S. Le Beux, and C. d'Alessandro. *Chorus digitalis : polyphonic gestural singing*. in *International Workshop on Performative Speech and Singing Synthesis*. 2011. Vancouver (Canada): University of British Columbia. 4p.

C4. Hung, H. and C. Jacquemin. *Encounter (Resonances)*. in *ACM International Conference on MultiMedia*. 2010. Firenze, Italy. 1421-1424.

C5. Jacquemin, C., W.-K. Chan, and M. Courgeon. *Bateau ivre: an artistic markerless outdoor mobile augmented reality installation on a riverboat*. in *ACM International Conference on MultiMedia*. 2010. Firenze, Italy. 10p.

C6. Jacquemin, C., G. Gagneré, and B. Lahoz. *Shedding light on shadow: Real-time interactive artworks based on cast shadows or silhouettes*. in *ACM International Conference on MultiMedia*. 2011. Scottsdale, Arizona, USA: ACM. 10p.

C7. Jacquemin, C. and B. Martin. *Interactive animation of a largescale crowd for art installations*. in *International Symposium on Electronic Art*. 2010. Ruhr, Germany. 5p.

C8. Le Beux, S., L. Feugère, and C. D'Alessandro. *Chorus digitalis : experiment in chironomic choir singing*. in *Annual Conference of the International Speech Communication Association*. 2011. Firenze, Italy: ISCA. 2005-2008.

C9. Mariette, N., B. Katz, K. Boussetta, and O. Guillerminet. *Sounddelta : a study of audio augmented reality using wifi-distributed ambisonic cell rendering*. in *Convention of the Audio Engineering Society*. 2010. London, UK. 15p.

Conferences without proceedings, workshops

D1. d'Alessandro, C. *Computerized Chironomy : Five Years of Gesture-Controlled Voice and Speech Synthesis at LIMSI*. in *International Workshop on Performative Speech and Singing Synthesis*. 2011. Vancouver, Canada.

KARINE BASSOULET

Présentation

Staff: 11 ITA CNRS & 4 temporary staff

Teams: Systems & Networks (AMIC), audiovisual (ou broadcasting), library, communication, training, infrastructure, management of "groupe direction "financial resources, logistics

Missions: to manage the common means of the laboratory for:

- a mutualized and optimal management and use of laboratory resources
- the most homogeneous and appropriate professionnal environment for all LIMSI members

Budget for 2011: 640 k€

Members of groupe direction are implicated in the laboratory life: they belong to the laboratory council as elected members and they lead some internal committees. Their professional skills are recognized beyond the laboratory: participation to regional professional networks (secretary, librarian, chief administrator), or to the national technical building agents network. They often are requested to participate to working groups or to juries of competitive examination for professional advancement.

Staff

Permanent Staff

Firstname	Lastname	Type of position	Employer	Arrival date	Departure date
Jean-Claude	Barbet	Res. Eng.	CNRS		
Karine	Bassoulet-Thomazeau	Res. Eng.	CNRS		
Cristelle	Berezaie	Adm. Staff	CNRS		Left on 31/01/2010
Magali	Brilhac-Roserat	Technician	CNRS		
Annie	Depauw	Technician	CNRS		
Pascal	Desroches	Technician	CNRS		
Pierre	Durand	Technician	CNRS		
Sébastien	Hamon	Adm. Staff	CNRS		Left on 01/04/2011
Olivier	Lassalle	Technician	CNRS	1/5/2012	
Daniel	Lerin	Technician	CNRS		Retired on 06/12/2010
Alexandre	Liège	Technician	CNRS		Left on 01/12/2011
Isabelle	Lollia	Adm. Staff	CNRS		
Sophie	Pageau-Maurice	Adm. Staff	CNRS		
Nadine	Pain	Adm. Staff	CNRS		
Elisabeth	Piotelat	Res. Eng.	CNRS		
Nicolas	Rajaratnam	Technician	CNRS		

Non permanent staff

| Firstname	Lastname	Type of position	Employer	Arrival date	Departure date
Abderahman	Azhar	Support Eng.	CNRS	01/05/2010	31/05/2012
Sarra	El Ayari	Support Eng.	CNRS	01/11/2009	31/12/2011
Mélanie	Falck	Administrative Staff	CNRS	01/02/2011	31/12/2012
Christophe	Jacquet	Administrative Staff	CNRS	15/12/2010	31/12/2012
Romain	Poirot	Technician Staff	CNRS	01/01/2011	31/10/2012

Activities

Computing resources (AMIC)

Staff: J.C. Barbet, A. Depauw, O.Lassalle, A. Liège, E. Piotelat, N. Rajaratnam, S. El Ayari

Budget for 2011: 90 k€

Significant actions

- New Firewall installation with redondancy and clustering mode.
- New router installation with 802.1Q Vlans segmentation.
- Netapp cluster storage installation for up to 16To
- New advanced high-performance backup solution with LTO4 Library and Atempo Time Navigator software
- Renew of more than 10 physical servers with more than 40 guest virtual servers with Xen/kvm virtualization technology
- New wireless infrastructure (Private & Eduroam)
- Windows Actice Directory architecture upgrade (AD2008)
- New mail and web architecture using reverse-proxy servers (Dovecot/Postfix/Perdition).
- LIMSI Information System update. Use of LDAP to manage user accounts and web services authentification.
- Development of new software for users account and bibliographic management.
- Studies for technical specifications for a new internal datacenter project. This project will be achieved in year 2012.

Principal goals for this new datacenter are scalability, security and energy efficiency for up to 150KW power consumption. Hot corridor containement, side cooling rack, water chilling with free cooling option, diesel generator set are the main requirements for this project.
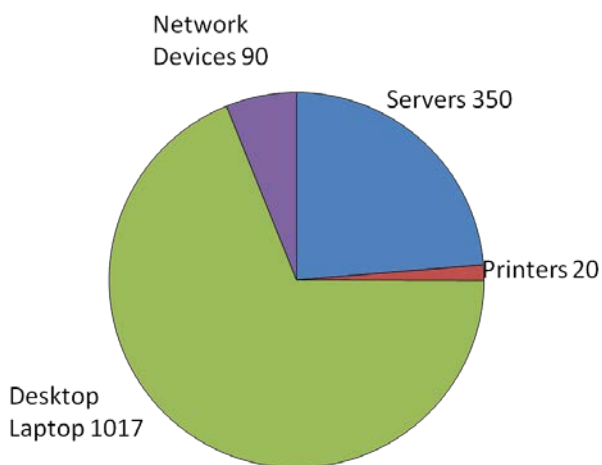
Library

Staff: M. Brilhac-Roserat, I. Lollia

- Laboratory collections (of documents) : 7445 documents and 8650 publications
- Changes in 2011 : 131 new documents, 77 books acquired; 474 registred publications (337 for CHM and 137 for ME)
- 39 books borrowed from other libraries and 205 papers requests

Budget for 2011: 72 k€

Significant actions:

- In association with AMIC, development of a new web interface intended to collect and manage the laboratory publications (PUBLIMSI)
- New arrangement of the reviews collections in the reading room of the library

Communication

Staff: S. Pageau-Maurice

Significant actions:

- Organization and welcome of the Euro VR-EVE 2010 « Joint European Meeting « First EuroVR-SIGs workshop & EVE inauguration », Orsay May 6th-7th 2010.
- Organization of the 1st "Ecole de Thermoacoustique", Roscoff, June 2010
- Participation to the editorial board of the DIGITEO Annual report 2010
- Participation and welcome to the DIGITEO Annual Forum, October 12th 2010
- Organization and welcome of the 5th AFRV Colloquim, Orsay, December 6th-8th 2010
- Organization of the 11th Ecole de Printemps de Mécanique des Fluides Numérique (June 2011, Roscoff)

Budget for 2011: 6 k€

- Organization & demonstration of researchers activities in the framework of the "Fête de la Science" (Orsay, October 21st-24th 2010 & October 14th-16th 2011

Production & dissemination of communication documents	
Paper scientific report 2010	500
Wish cards 2010 & 2011	4000

Building and equipments maintenance

Staff: P. Desroches, R. Poirot

Significant actions:

- Maintenance of LIMSI's four buildings (6000m^2)
- Refurbishing of 4 to 6 offices a year, including electricity and lighting renewal, wall painting, floor renewal and new furniture
- Maintenance of all equipments, elevators, climatisaton equipments, electricity suppliances

Budget for 2011: 171 k€

- Creation of a new room dedicated to experiments in acoustics
- Technical instruction (electricity supply, climatisation) and planning of the future datacenter to be installed at the end of 2012

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Logistics

Staff: P. Durand

Significant actions:

- Installation of a video conference system
- Renewal of all photocopiers

Budget for 2011: 15 k€

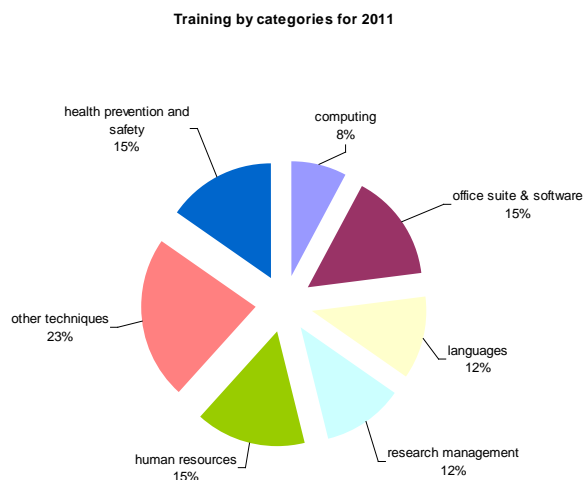- Implementation of a controlled access system for the four buildings

Training

Staff: I. Lollia, K. Bassoulet

Budget for 2011: 7.7 k€ (training financed with laboratory funds like the "doctoriales")

Significant actions: 59 agents trained, 73 different training courses in 2010 and 2011

Training by categories for 2011

- health prevention and safety 15%
- computing 8%
- office suite & software 15%
- languages 12%
- research management 12%
- human resources 15%
- other techniques 23%

Health Prevention and Safety

Staff: A. Choisier, L. Pointal, ACMO

Budget 2011: 10 k€ including fire extinguishers maintenance; fire detection and alarm maintenance; electrical and technical facilities annual control; individual protection kits for experiments.

Significant actions:

- Annual Health And Security Comity: reports on legal maintenance of facilities, professional accident, training operations, periodic medical examination of LIMSI members; remaining identified problems and planned actions.
- Monthly security visit of the laboratory for newcomers (58 people in 2011).
- Update of the laboratory single risk assessment form (Document Unique).
- Incentive for new training of first aid workers (Sauveteur Secouriste du Travail). After a regular decrease of trained people during last years, the situation is now corrected with five new people in 2011 (currently 16 people with SST, five with PSC1).
- Naming of floor leaders for evacuation.
- Organization of evacuation exercise on fire alarm.
- Upgrade of security on physical experiments: new experiment with laser and heavy sound risks, old high temperature and pressure experiment reviewed and revised for risks.
- Security stickers in each room, remaining important security informations, procedures and numbers, complete room location and phone number contact.
- Security poster at circulation places, with emergency numbers and up to date list to contact first aid worker in the laboratory.
- Installation of two semi-automatic defibrillators (in 508 building and in S building).
- Information feedback and requests to University and district about security of pedestrian moves among the different laboratory's buildings.
- Short but heavy security operations on AFRV 2010 organization, mainly due to security rules with large marquee installation for lunch.
- Prevention plan for external enterprises done by substructure unit, following plans established during previous years.

Administration

Staff : K. Bassoulet, C. Jacquet (gestion), N.Pain (personnel)

Laboratory budget

The funded budget of the laboratory was 13.3 M€ in 2011. 8.2 M€ represents the wages of the permanent staff (managed directly by the permanent staff employers) and 5.1 M€ the receipts.

Evolution of LIMSI funded budget
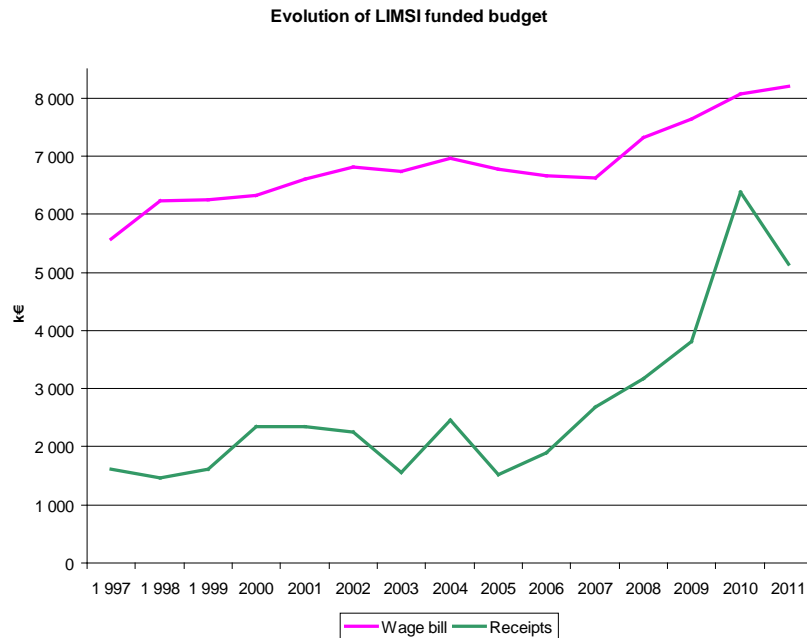
In 2011, the federal grant (CNRS, UPSUD and UPMC) represented 22% of laboratory receipts and the 78 % remaining acome from our own resources. Since 2008, the laboratory has benefitted from significant fundings, through the participation of groups TLP and ILES to the QUAERO program.

2011 funded budget
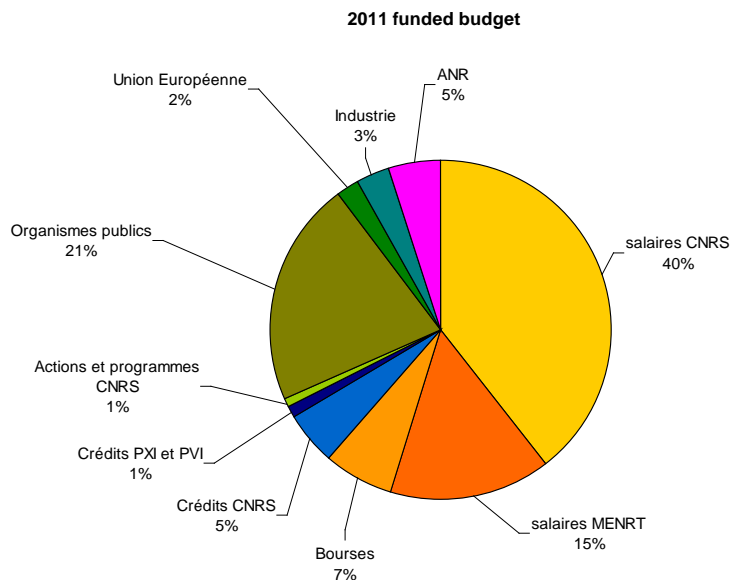
The above chart shows the breakdown of our total budget, including salaries, as a function of the nature of the support. 40% are the salaries of the CNRS employees, and 15% correspond to the salaries of the University employees.

Evolution of financial resources (state grant and own resources)

Legend:
- ANR
- Redevances
- Agences de moyens
- Industrie
- Union Européenne
- Organismes publics
- Actions et programmes CNRS
- Quadriennal PXI et PVI
- Soutien de base CNRS
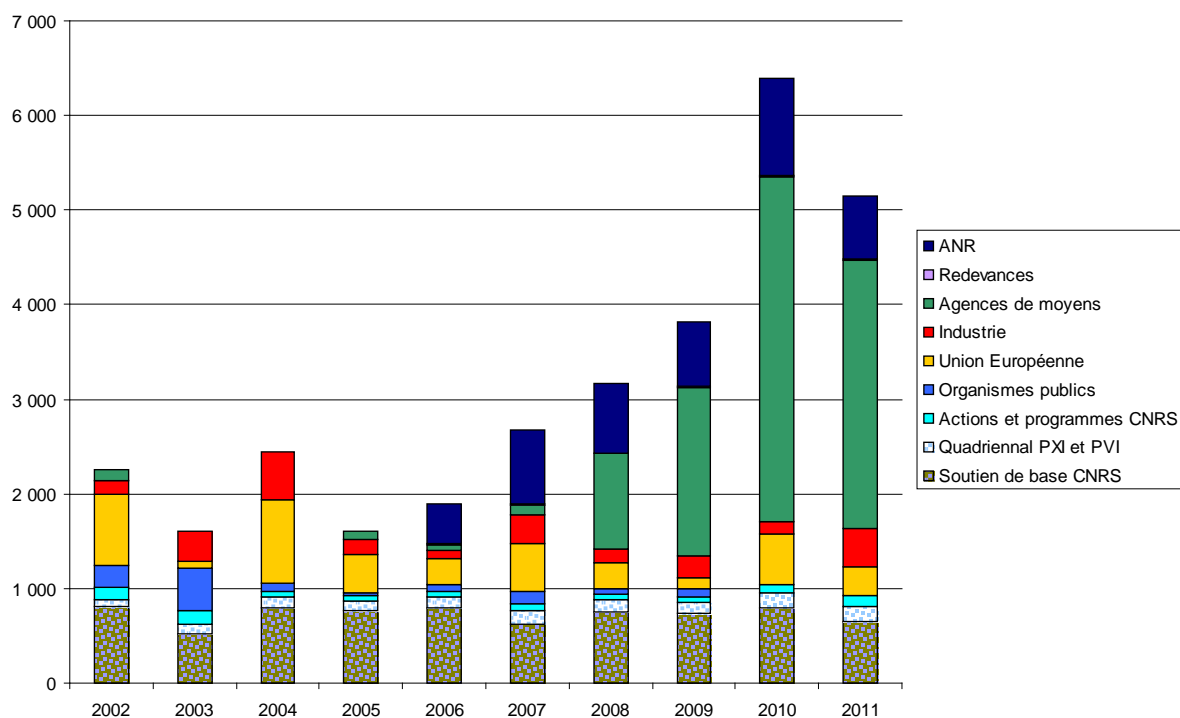
The above chart shows the evolution of our financial resources and its breakdown as a function of their origin.

Expenses by nature without permanent staff wages

Legend:
- INFRASTRUCTURE
- EQUIPEMENT
- FONCTIONNEMENT
- PERSONNEL
- MISSIONS
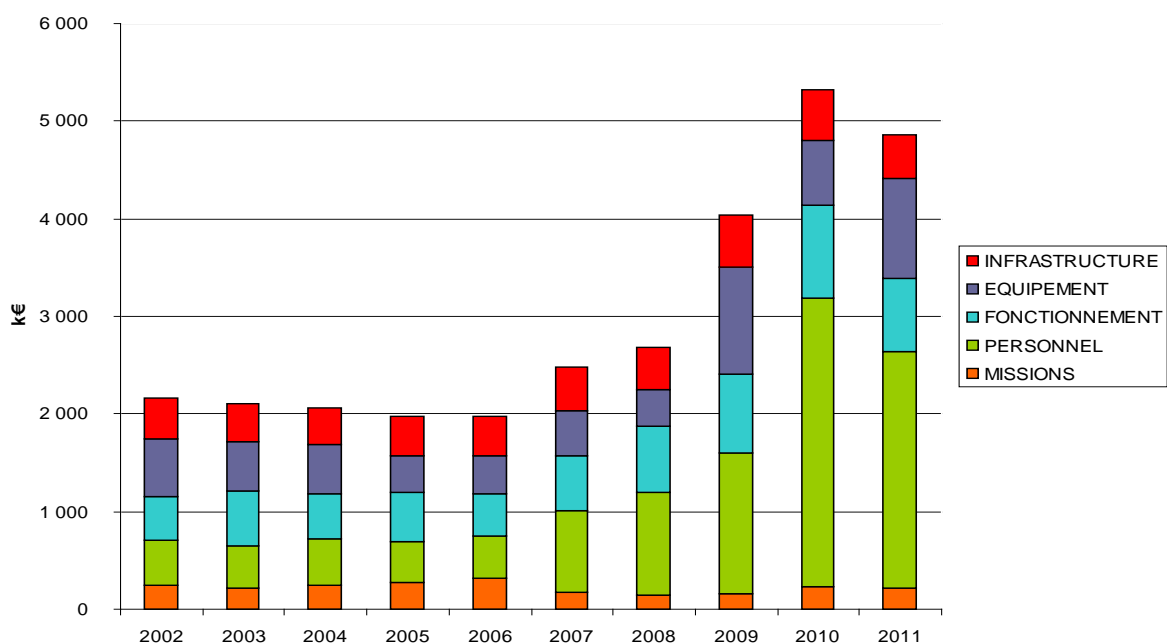
The above chart shows the breakdown of our expenses and its evolution with time. We can notice the strong evolution of temporary personnal expenses due to the participation to the QUAERO program.

Staff

Evolution of main staff categories

Legend: ■ Chercheurs ■ Ens. Ch. ■ ITA IATOS ■ Doctorants ■ Stag.Post doc.CDD.Coll Ext
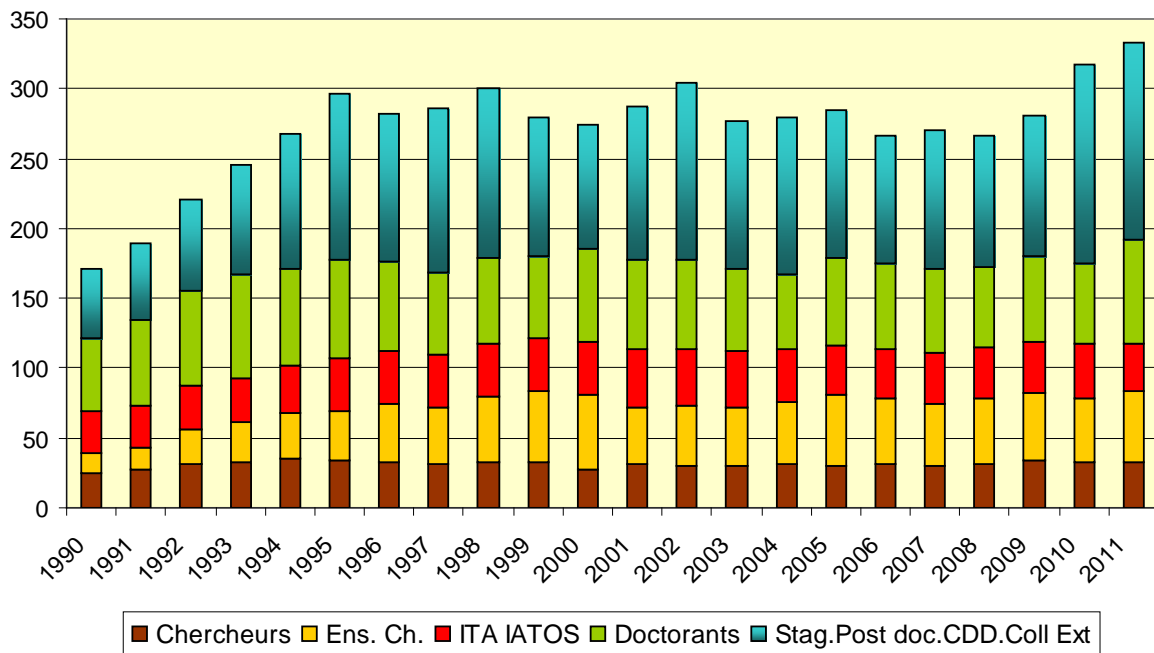
Distribution of staff categories in 2011

stagiaires 74
Chercheurs 33
ITA/IATOS 35
coll. extérieurs 3
chercheurs ass./collab. bénévoles 4
visiteurs 7
CDD(h/an) 31
post-doc 22
Doctorants 74
Enseignants-chercheurs/ATER 50
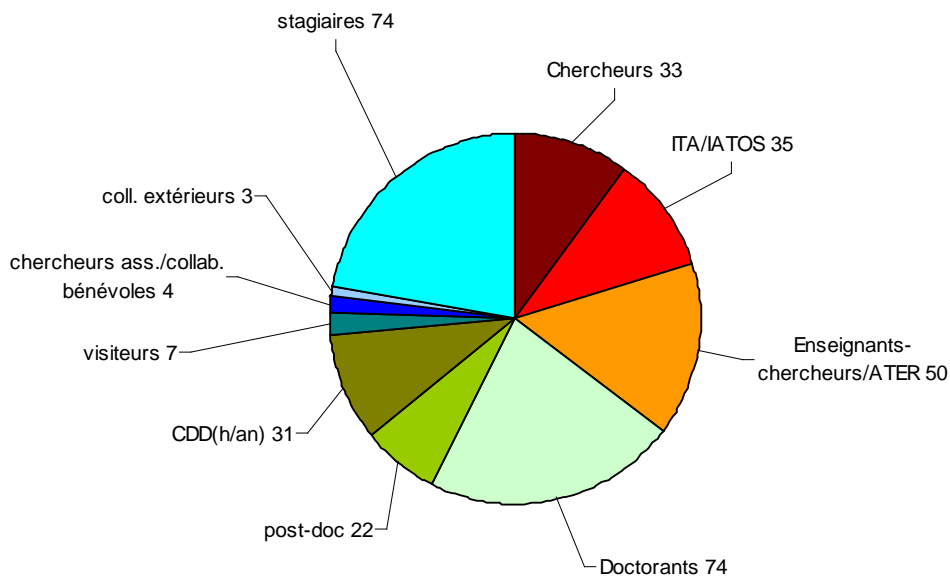
Partnerships and Valorization

- The implementation of patnership policy of LIMSI direction is achieved through the following of each project, from the first contacts with potential partners. This approach is reinforced by awareness actions on intellectual property issues and on confidentiality rights and obligations.

- We take a special interest for Software and database protection and the various methods to achieve it.

The graph below shows the distribution of different types of partnerships concluded in 2010 and 2011.

Distribution of partnership 2010 & 2011
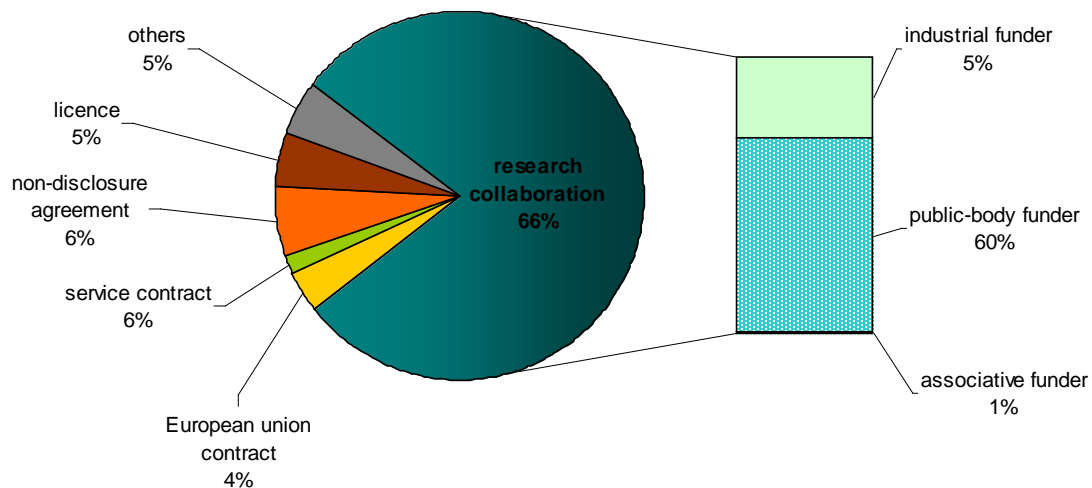
Ongoing valorization actions:

- Registration of two softwares (MR_CHORUS and OLORIN) at the agency for the protection of programs (APP)
- Licence agreement for these two softwares
- Patent : Katz, B.F.G. and Schönstein, D., « Method for selecting perceptually optimal HRTF filters in a database according to morphological parameters », French Patent N° WO/2011/128,583, 20/10/2011

- Y. Bellik and G. Pruvost, Youpi : Open source UPNP software library, developed in the context of the ATRACO European project http://sourceforge.net/projects/youpi/files/
- W. A. Turner: UNOPORUNO, a Free License Software, for computer supporting sociological research into the impact of talent mobility on socio-economic development
- Start-up creation : Nomoseed created by Cédric Coussinet, PhD in CPU group

Researchers

Firstname	Lastname	Type of position	Employer	HDR	CoNRS section	Arrival date	Departure date
Martine	Adda-Decker	DR	CNRS	HDR	34	01/10/1990	Left on 01/10/2010
Marianna	Apidianaki	CR	CNRS		7	01/10/2011	
Malika	Auvray	CR	CNRS		27	01/10/2008	
Dominique	Béroule	CR	CNRS		7	01/03/1988	
Jean-Baptiste	Berthelin	CR	CNRS	HDR	7	01/07/1985	
Philippe	Boula De Mareüil	CR	CNRS	HDR	34	01/01/2002	
Patrick	Bourdot	DR	CNRS	HDR	7	01/10/1992	
Annelies	Braffort	DR	CNRS	HDR	7	01/03/1992	
Hervé	Bredin	CR	CNRS		7	01/09/2010	
Christophe	D'Alessandro	DR	CNRS	HDR	7	01/10/1989	
Michel	Denis	DR	CNRS	HDR	27	01/01/1992	Emeritus as of 09/2008
Yohann	Duguet	CR	CNRS		10	01/10/2009	
François	Feuillebois	DR	CNRS	HDR	10	01/01/2010	Retired on 01/09/2011
Michael	Filhol	CR	CNRS		7	01/10/2010	
Jean-Luc	Gauvain	DR	CNRS	HDR	7	01/10/1983	
Damir	Juric	CR	CNRS		10	06/12/2005	
Brian	Katz	CR	CNRS	HDR	7	01/11/2002	
Lori	Lamel	DR	CNRS	HDR	7	01/10/1991	
Olivier	Le Maitre	DR	CNRS	HDR	10	01/10/2007	
Patrick	Le Quéré	DR	CNRS	HDR	10	01/01/1987	
Jean-Sylvain	Liénard	DR	CNRS	HDR	7	01/10/1972	Emeritus as of 09/2007
François	Lusseyran	CR	CNRS	HDR	10	03/04/2000	
Joseph-Jean	Mariani	DR	CNRS	HDR	7	01/09/1974	
Lionel	Mathelin	CR	CNRS		10	01/10/2003	
Angel	Osorio Sainz	DR	CNRS	HDR	7	01/10/1973	
Bérengère	Podvin	CR	CNRS	HDR	10	01/10/1998	
Michel	Pons	DR	CNRS	HDR	10	01/07/1987	
Albert	Rilliard	CR	CNRS		34	01/01/2007	
Sophie	Rosset	DR	CNRS	HDR	7	01/10/2002	
Jean-Luc	Rouas	CR	CNRS		7	01/10/2008	Left on 31/08/2010
Gérard	Sabah	DR	CNRS	HDR	34	01/05/1985	
Jean-Paul	Sansonnet	DR	CNRS	HDR	7	01/09/1998	
Denisse	Sciamarella	CR	CNRS		9	01/10/2002	
Christian	Tenaud	DR	CNRS	HDR	10	15/09/1992	
Ioana	Vasilescu	CR	CNRS		34	01/01/2006	
Pierre	Zweigenbaum	DR	CNRS	HDR	7	01/11/2006	

Professors and Assistant-professors

Firstname	Lastname	Type of position	Employer	HDR	CNU section	Arrival date	Departure date
Alexandre	Allauzen	Ass. Prof.	U-PSud		27	01/10/2005	
Mehdi	Ammi	Ass. Prof.	U-PSud		27	01/09/2006	
Jairaj	Amrit	Ass. Prof.	U-PSud	HDR	62	01/09/1996	
Cécile	Balkanski	Ass. Prof.	U-PSud		27	01/12/1993	

Diana	Baltean	Ass. Prof.	UPMC		60	01/09/2002	
Claude	Barras	Ass. Prof.	U-PSud	HDR	27	01/02/2000	
Yacine	Bellik	Ass. Prof.	U-PSud	HDR	27	01/09/1996	
Céline	Clavel	Ass. Prof.	U-PSud		16	01/09/2011	
Claudine	Dang Vu	Prof.	U-PSud	HDR	60	01/10/1992	
Marie-Paule	Daniel	Ass. Prof.	U-PSud		16	01/01/1992	
Françoise	Darses	Prof.	U-PSud	HDR	16	01/10/2008	Left on 31/05/2011
Virginie	Daru	Ass. Prof.	ENSAM		60	03/09/2001	
Gérard	Defresne	Ass. Prof.	U-PSud		62	01/10/1993	
Ivan	Delbende	Ass. Prof.	UPMC	HDR	60	01/10/1998	
Nathalie	Delprat	Ass. Prof.	UPMC		60	01/01/2008	
Laurence	Devillers	Prof.	Paris IV	HDR	27	01/05/1984	
Marie-Christine	Duluc	Ass. Prof.	CNAM	HDR	62	01/10/1993	
Thierry	Faure	Ass. Prof.	UPMC	HDR	60	10/11/2002	On leave at Ecole de l'Air as of 30/09/2011
Nicolas	Ferey	Ass. Prof.	U-PSud		27	01/11/2009	
Mouaouia	Firdaouss	Ass. Prof.	UPMC	HDR	60	07/08/1990	
Maurice-Xavier	François	Prof.	UPMC	HDR	60	01/10/1993	Retired on 31/12/2011
Emmanuelle	Frenoux	Ass. Prof.	U-PSud		27	01/10/2005	
Brigitte	Grau	Prof.	ENSIIE	HDR	27	01/06/1985	
Wietze	Herreman	Ass. Prof.	U-PSud		60	01/09/2010	
Gabriel	Illouz	Ass. Prof.	U-PSud		27	14/10/1996	
Christian	Jacquemin	Prof.	U-PSud	HDR	27	02/02/1998	
Fathi	Jebali Jerbi	Ass. Prof.	UPMC		60	01/10/1993	
Smaïne	Kouidri	Prof.	UPMC	HDR	60	01/09/2007	
Gérard	Labrosse	Prof.	U-PSud	HDR	60	01/09/1989	Retired on 31/08/2011
Anne-Laure	Ligozat	Ass. Prof.	ENSIIE		27	01/09/2009	
Jean-Claude	Martin	Prof.	U-PSud	HDR	27	01/09/1997	
Laurent	Martin Witkowski	Ass. Prof.	UPMC		60	01/09/2001	
Aurélien	Max	Ass. Prof.	U-PSud		27	01/09/2004	
Hélène	Maynard	Ass. Prof.	U-PSud	HDR	27	01/03/1984	
Véronique	Moriceau	Ass. Prof.	U-PSud		27	01/09/2008	
Caroline	Nore	Prof.	U-PSud	HDR	60	01/09/1996	
Luc	Pastur	Ass. Prof.	U-PSud		60	01/09/2004	
Stéphanie	Pellerin	Ass. Prof.	U-PSud		60	01/10/1997	
Chi-Tuong	Pham	Ass. Prof.	U-PSud		60	01/09/2008	
Isabelle	Robba	Ass. Prof.	UVSQ		27	01/10/1987	
Anne	Sergent	Ass. Prof.	UPMC		60	01/09/2001	
Xavier	Tannier	Ass. Prof.	U-PSud		27	01/09/2007	
Philippe	Tarroux	Prof.	ENS Ulm	HDR	27	10/11/1998	
Frédéric	Vernier	Ass. Prof.	U-PSud		27	01/09/2002	
Anne	Vilnat	Prof.	U-PSud	HDR	27	01/06/1985	
Catherine	Weisman	Ass. Prof.	UPMC		60	02/10/1995	
Guillaume	Wisniewski	Ass. Prof.	U-PSud		27	01/09/2008	
François	Yvon	Prof.	U-PSud	HDR	27	01/09/2007	

Engineers, Technicians and Administrative Staff

Firstname	Lastname	Type of position	Employer	Arrival date	Departure date
Gilles	Adda	Res. Eng.	CNRS	01/12/1991	
Jean-Claude	Barbet	Res. Eng.	CNRS	01/07/2009	
Karine	Bassoulet-Thomazeau	Res. Eng.	CNRS	01/11/2004	
Cristelle	Berezaie	Adm. Staff	CNRS	05/02/2007	Left on 31/01/2010
Eric	Bilinski	Res. Eng.	CNRS	01/12/2003	

Laurence	Bolot	Res. Eng.	CNRS	01/05/2000	
Vincent	Bourdin	Res. Eng.	CNRS	06/02/1998	
Magali	Brilhac-Roserat	Ass. Eng.	CNRS	01/09/2002	
Sylvain	Caillou	Res. Eng.	CNRS	01/12/2008	
Dorine	Caqueret	Technician	CNRS	01/01/2011	
Jalel	Chergui	Res. Eng.	CNRS	01/01/2005	
Annick	Choisier	Res. Eng.	CNRS	01/07/1987	
Tuan	Dang Anh	Res. Eng.	CNRS	01/01/1989	
Annie	Depauw	Technician	CNRS	01/07/2001	
Pascal	Desroches	Technician	CNRS	01/10/2000	
Pierre	Durand	Technician	CNRS	01/04/1994	
Yann	Fraigneau	Res. Eng.	CNRS	01/06/1999	
Jean-Jacques	Gangolf	Res. Eng.	CNRS	01/09/1976	
Vincent	Gautier	Technician	UPMC	01/12/2007	
Cyril	Grouin	Res. Eng.	CNRS	01/10/2006	
Sébastien	Hamon	Adm. Staff	CNRS	01/06/2009	Left on 01/04/2011
Carole	Hoint	Adm. Staff	CNRS	14/03/2011	
Martine	Hurault-Plantet	Res. Eng.	CNRS	01/10/1989	Retired on 10/09/2010
Olivier	Lassalle	Ass. Eng.	CNRS	01/05/2012	
Daniel	Lerin	Ass. Eng.	CNRS	31/05/1999	Retired on 06/12/2010
Alexandre	Liège	Ass. Eng.	CNRS	01/12/2008	Left on 01/12/2011
Isabelle	Lollia	Adm. Staff	CNRS	12/02/2001	
Yves	Maire	Technician	U-PSud	03/09/2007	
Sophie	Pageau-Maurice	Adm. Staff	CNRS	01/01/1993	
Nadine	Pain	Adm. Staff	CNRS	01/05/1991	
Patrick	Paroubek	Res. Eng.	CNRS	01/07/1997	
Elisabeth	Piotelat	Res. Eng.	CNRS	02/01/2002	
Laurent	Pointal	Res. Eng.	CNRS	02/10/2003	
Nicolas	Rajaratnam	Technician	CNRS	01/12/2006	
Valérie	Ronflé	Adm. Staff	CNRS	12/11/2002	
Laurence	Rostaing	Adm. Staff	CNRS	01/12/2008	
Damien	Touraine	Res. Eng.	CNRS	01/12/2006	
William	Turner	Res. Eng.	CNRS	15/09/1998	
Cyril	Verrecchia	Ass. Eng.	CNRS	01/12/2006	
Jean-Marc	Vézien	Res. Eng.	CNRS	04/01/2002	

LIMSI Organization- 2012

(The names of the heads appear in italics)

Administrative coordination
K. Bassoulet, M. Falck (CDD)

HMC dpt : C. Hoint, L. Rostaing
Mechanical dpt : V. Ronflé
Central Services Group : N. Pain,
C. Jacquet (CDD)

Management

Director : P. Le Quéré
Deputy Director : A. Vilnat
Administrator : K. Bassoulet, M. Falck (CDD)
Secretary : N. Pain

Advisory Council

Security
L. Pointal
A. Choisier

Central Services Group
K. Bassoulet, M. Falck (CDD)

AMIC (Computers): J.C. Barbet, A. Azhar,
A. Depauw, O. Lassalle, E. Piotelat, N. Rajaratnam
Library : M. Roserat, I. Lollia
Public Relations : S. Pageau-Maurice
Infrastructure: P. Desroches, R. Poirot (CDD)
Training : I. Lollia
Logistics & Audiovisual : P. Durand
Secretary : C. Jacquet (CDD)

Human-Machine Communication department
A. Vilnat, Secretaries : C. Hoint, L. Rostaing

VIDA (Virtuality, Interaction, Design & Art) : C. Jacquemin, N. Delprat

Information, Language, writtEn & Signed
P. Zweigenbaum

Corpora & representations
P. Paroubek

Multilinguism and paraphrasing
A. Max

Information extraction, Focused information retrieval & Question-Answering
P. Zweigenbaum

Sign Language modelling & processing
A. Braffort

Spoken Language Processing
J.L. Gauvain

Speaker characterization
C. Barras

Affective & social dimensions of spoken interactions
L. Devillers

Perception & automatic processing of variation in speech
P. Boula de Mareüil
I. Vasilescu,

Robust analysis of spoken language & dialog systems
S. Rosset

Translation & machine learning
F. Yvon

Speech recognition
L. Lamel

Language resources
G. Adda

Audio & Acoustic
C. d'Alessandro

Sound & Space
B.F.G. Katz

Expressive prosody
A. Rilliard

Audio analysis & synthesis
C. d'Alessandro

Architecture and Models for Interaction
J.P. Sansonnet

Image & Interaction
E. Frenoux

Ambient & Interaction
Y. Bellik

Haptic interaction & communication
M. Ammi

Interaction on tactile surfaces
F. Vernier

Perception, Cognition & Uses
J.C. Martin

Perceptual systems & models
Ph. Tarroux

Image, language, space
M. Denis

Cognitive ergonomics
F. Darses

Virtual Agents and Emotions
J.C. Martin

RV&A VENISE
P. Bourdot

Interaction models for V&AR
P. Bourdot

Data models & simulations
N. Férey
J.M. Vézien

Mechanical & Chemical Engineering department
P. Le Quéré, Secretary : V. Ronflé

Thermoacoustics-Cryogeny Transverse Action : P. Le Quéré
CIGITA (Computer Graphics & Thermoaeraulic Engineering Support) : J. Chergui, A.T. Dang, Y. Fraigneau
Experimental Support : V. Bourdin, D. Caqueret, V. Gautier, Y. Maire

Unsteady Aerodynamics
C. Tenaud

High performing numerical methodologies
O. Le Maître

Unsteady flows
F. Lusseyran

Manipulation and flow control
B. Podvin,
L. Mathelin

Convection & Rotation
C. Nore

Buoyant convection
A. Sergent

Free surface flows
C. Dang-Vu
C.T. Pham

Rotating and shear flows
I. Delbende,
L. Martin-Witkowski

Magnetohydrodynamics
C. Nore

Solid-Fluid Transfer
M. Pons

Two-phase flows : dynamics and transfers
M.C. Duluc, D. Juric

Oscillating flows : dynamics and transfers
D. Baltean, S. Kouidri

Heat transfer from solid to superfluid helium
J. Amrit

Applied convective transfers
M. Pons